SOILS

ERME II

Volume 2

Tulare County, California

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Local agencies need to be given information helpful in deciding how physical characteristics of soil can assist in determining land use, in relation to the long range preservation of soil capabilities. Attempts to identify the interrelationships between various soil factors and man's activities, as currently understood in the field of soil science. Translates these relationships into meaningful plans and policies for the use of land and intensities of growth in the County. Provides understanding of detailed soil survey, shows how interpretive analyses of soil factors may be of benefit in environmental management programs. Characteristics are evaluated for waste disposal, transportation, recreation, extraction of materials, agriculture, water management and urban uses. Includes interpretive maps and tables.

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CHAPTER I

SUMMARY

The nature of the soil exerts a strong influence on the manner in which man uses the land. Hence, it is important that soil factors be given appropriate consideration in any decision relating to man's use of his environment. This involves public recognition of the intrinsic ability of the land to tolerate or reject specific types of uses and intensities of use. Simply stated, local agencies should be given the information which will be helpful in deciding how physical characteristics of soil can assist in determining land use in relation to the long range preservation of soil capabilities.

Soil resources are truly one of the most important elements of Tulare County's natural resource base. Furthermore, mounting pressures for growth and development are constantly making this resource more and more valuable. This plan element attempts to identify the interrelationships between various soil factors and man's activities as currently understood in the field of soil science. The plan goes further, however, by translating these relationships into meaningful plans and policies for the use of land and directions and intensities of growth in the County.

The purposes of this plan element are:

--To provide a factual document which can be used as a decision-making tool in the development of general and specific plans which are more responsive to the limitations set down by nature.

--To provide an understanding of the detailed soil survey and to show how its interpretive analyses of soil factors may be of benefit in the environmental management programs.

--To add to the environmental policy package, the principle thrust of which is to give decision-makers a firm basis to evaluate land use proposals in relation to physical characteristics.

--To recommend improvements in the County's land use control regulations and guidelines which incorporate the findings made in this document.

Intelligent decision-making in land use planning requires precise knowledge of the physical characteristics of the land and its limitations, and some idea of the associated risks. This plan element outlines the basic soil behavioral characteristics which are of concern to planners, architects and engineers (Chapter IV). These characteristics are then more intensely evaluated for specific use (Chapter VI) such as for waste disposal, transportation, recreation, extraction of materials, agriculture, water management, and urban development in general. In effect, Chapter VI sets forth the guidelines for determining soil capabilities for various uses as currently recognized by the Soil Conservation Service of the United States Department of Agriculture.

Ways in which the County may strengthen its plans, policies and regulations to account for soil factors are the subject of Chapter VII of this report. Here is the real substance of the plan, the essence being the development of a land capability strategy as a means of solving planning conflicts (Section B-2). Other meaningful techniques discussed in the chapter include: Use of zoning controls, subdivision regulations, building and plumbing codes, and development of a County growth policy.

The interpretive maps found throughout the document are a major feature of the report. This is the first comprehensive attempt by any agency in the County to delineate the significant soil characteristics of the landscape which may influence or direct growth and development in the County. These maps are invaluable as a general planning tool. Decision-makers will be able to see at a glance the interrelationships of the various physical components of the land, and, thus be able to render more informative decisions.

General descriptions of the major soil groups and associations identified in the County are found in Chapter V. Although the soils identified here are not defined to the level of precision expected in a detailed soil survey, the descriptions are considered sufficient to allow their use in the general planning process.

Failure to recognize the limitations of local soils in this area created this damage. The house has been severely damaged by soil movement of unconsolidated materials. An understanding of soil mechanics is important in any development or building program.

Source: USDA Soil Conservation Service

Chapter II

Policy Statements

CHAPTER II

POLICY STATEMENTS

A. GENERAL RECOMMENDATIONS

A-1. Encourage, by every means possible, the accomplishment of an up-to-date soil survey at the earliest possible date.

A-2. A soil overlay zone should be adopted in order to provide an added layer of protection against especially difficult soil hazards. These should include provisions which recognize the hazards of shrink-swell behavior, steep topography, and poor absorptive qualities for sewage disposal, **as well as other problems identified in this element. Within Urban Improvement Areas, where lands may be extremely valuable, urban density zoning may appropriately be applied regardless of soil problems, providing long term (permanent) physical systems are incorporated in development to compensate for the soil hazard. Such developments must make provisions for protection of public safety. Development regulations should require, for example, special engineering specifications in areas having poor foundation support because of shrink-swell, low bearing strength, or other hazardous soil conditions.**

A-3. Special areas identified as significant public value areas should include the following, where identified:

- Areas for groundwater recharge
- Areas of low bearing strength
- Prime agricultural soils
- Areas of high erosion potential
- Wet land areas
- Areas of excessively sloping land (over 25% slopes)
- Areas with severe limitations for septic tank systems
- Rock, sand and gravel deposits, and other areas of high mineral resource value.

A-4. **Areas classified as prime agricultural land should be preserved for agricultural use when outside of Urban Boundaries. The existence of Urban Boundaries should not be used to justify leap-frog or scattered development on prime agricultural soils even though within the Urban Boundaries (Class I, II & III soils).**

A-5. Significant deposits of sand and gravel should be reserved as open space until they can be developed. Any significant deposits of sand and gravel within urban areas should be identified and marked on a countywide resources map. Such areas should be zoned for resource extraction until such extraction has been completed, and then zoned for subsequent uses.

A-6. Matrix should be developed with listing of all soils and ratings for various uses such as residential, industrial, commercial, septic tank, drainage fields, intensive animal wastes, lagoons, roads and railroads, airport runways, campgrounds and picnic areas, cultivated crops, grass lands and forests.

A-7. Adopt adequate grading, erosion and sedimentation control ordinances to apply to all subdivision and parcel map developments. To assure conformance to the ordinances, a performance bond should be required.

B. HAZARDOUS CONDITIONS

B-1. Areas subject to slides or severe hazards to public safety, such as soils which cannot provide a good foundation under any circumstances, must be placed in open space zones where construction of buildings is prohibited.

B-2. Areas of excessive slope (or over 15%) should not be used for ordinary development purposes but only with special care and extraordinary design features.

B-3. Areas of high water table and unstable soil conditions should be placed in open space zoning.

B-4. Attempts should be made to direct the acquisition of park and open space land in areas where the soil has such problems as to make urban improvements unduly expensive. The assessor should be encouraged to assess the value of such hazardous lands significantly below land which does not have such hazards and consequent high development costs.

B-5. Areas dominated by soils which exert severe limitations for urban development shall be retained in open space or low intensity uses.

C. SEWAGE DISPOSAL

C-1. When zone changes occur with regard to existing uses, the Zoning Ordinance should be amended to provide for the connection of such uses to community sewer systems, where those systems exist within 1,320 feet of the parcel of land containing the use (where such uses are not now connected to community systems).

C-2. Soils defined as having severe limitations for septic tanks such as hardpan, high water table, etc., should not be allowed to be developed for improved use such as residential, commercial or industrial unless they are on community sewer systems.

C-3. Areas should be identified within Urban Boundaries in which soils are not suitable for onsite disposal of sewage effluent. These areas could then be designated for small lot development, where urban development should only be permitted when it can be connected to community utility systems. In areas of moderate limitation, urban development should be carefully considered and approached with caution when developed without the use of community systems.

C-4. All occupied buildings proposed to be constructed within 1,320 feet of a community sewer line should be required to connect to such a system.

C-5. Large lot zoning of land in areas where septic tank effluent cannot be handled well within existing soil limitations should not be allowed. Public sewer systems are economically infeasible in such areas; therefore, when outside feasible service areas for community sewer systems, land should not be divided for urban or suburban uses or allowed building permits for occupied structures, other than farm dwellings.

C-6. Structures and onsite sewage disposal systems should be prohibited in primary flood plains, and permitted only in secondary flood plains when appropriate protective devices are used.

C-7. Percolation tests should not be performed in the summer when the soil is dry and the water table is deep in the soil, but rather from April-June, for use in determining adequacy for septic tank installation.

C-8. Percolation should always be examined for relationship to flood plains and surface water streams. If percolation tests show extremely high percolation rates near streams, septic tanks should be prohibited.

C-9. High percolation rates on steep slopes indicate a potential for hazardous surfacing of effluents. Septic tank systems should be prohibited in such places.

C-10. Sewage lagoons for community systems, if such systems are used, should not be permitted in areas with severe limitations for sewage lagoons. In areas with moderate limitation, careful consideration should be given to the hazard before approving such lagoons, and appropriate conditional safeguards required.

D. EROSION

D-1. Recommend that vegetational borders around edges of farm fields be left as an aid in reducing wind-caused erosion. Wind breaks set in strips at right angles to the prevailing wind, at intervals, are also helpful and are recommended.

D-2. Erosion problems can be especially difficult in areas undergoing conversion to urban uses, where irrigation has been terminated, or construction practices have removed the top layers of soil. Where land has been cleared and is being held for urban uses, require ground cover to be sown (such as annual grasses), or other means of holding the soil be applied until landscaping can be completed.

E. GROUNDWATER RECHARGE AREAS

E-1. Groundwater recharge areas shall be reserved in open space zones wherever they can be determined to be of substantial use. Such action would preclude the installation of impervious materials covering the surface of the ground, unless there are unusual extenuating circumstances.

E-2. Require in large areas of paving, such as commercial or industrial areas, an underground drainage system which will be tied to storm systems, or preferably directed to collection basins so that polluting runoff will not percolate into groundwater without filtration and soil bacterial action.

E-3. Where ponding lots are utilized for provision of drainage facilities, attempts should be made to locate them in areas where the soil is suitable for groundwater recharge.

E-4. In areas set aside for urban growth, that are within Urban Area Boundaries, recharge areas could be suggested for use as parks, school sites, and other open space uses. Within these uses, porous paving could be used (such as cedar chips or other type of covering) which would establish a minimum covering requirement without preventing percolation.

E-5. Individual septic systems and attendant leach lines or pits should be located on the same parcel of land as the structures or facilities served.

Chapter III

The Environmental Resources Management Element

CHAPTER III

A. THE ENVIRONMENTAL RESOURCES MANAGEMENT ELEMENT

Implicit to most of the new and expansive planning legislation of the State of California is that local governments develop an environmental management approach to all of those planning activities and implementation programs which relate to the quality of the environment. Under this concept, basic studies should be undertaken which would lead toward action programs designed to avoid degradation of the environment and to offset that degradation which has occurred. Consequently, Tulare County has conceived the concept of an Environmental Resources Management Element (ERME). This approach avoids the pitfalls inherent in the traditional function-by-function planning methodologies and ensures a coordinated attack on all facets which comprise the field of environmental management.

Under the authority granted in California Senate Resolution 202, of 1971, the Phase I Environmental Resources Management Element, adopted in June, 1972, provided a means to identify the most significant environmental issues which require action in the short term. It therefore was used to identify the magnitude and location of natural resources which have critical value in maintaining and enhancing the quality of the environment, but which, if short term action is not taken, are likely to be lost through urban expansion or from overuse or exploitation for nonurban purposes. It presented broad levels of policy consideration and recommendations, while recommending that subsequent phases of Environmental Management be based on greater depth and breadth of analysis.

Phase II (ERME II), the second year in the Environmental Resource Management Program, centered around the in-depth exploration of important issues which had been discussed in Phase I; issues and conflicts which arose from pressures for the development of land and use of resources. The issues which were recognized as being of vital importance in this context include water pollution, protection of biological resources including rare and endangered species, and the establishment of a systematic review for environmental concerns.

In the matter of water pollution, two aspects became obvious as matters around which substantial policy decisions must be made: (1) the disposition of animal wastes, both as point and non-point sources, and the control of their harmful and degrading influences on the quality of both ground and surface waters, as well as the soil; (2) the use of soil with relation to various land uses, where misuse could cause the loss of the essential soil resource and the degradation of adjacent and intermingled resources such as ground and surface water, flora, fauna, and air.

Volume 2, ERME II, the Soils Element of the Tulare County General Plan, is therefore, an in-depth examination of the properties and uses of soils of the County and the development of policies for determining their protection and use as an essential and nonreplaceable resource.

Source: USDA Soil Conservation Service

Severe erosion of roadways is the inevitable result of simply cutting out a dirt track in a hillside. Appropriate paving and drainage facilities would help to avoid such destruction. Not seen in this picture is the destruction of downstream drainage and ponds where mud and silt fill them to the point of making them worthless. In the long run more money is spent to correct the problems than would have been necessary to construct the roadway correctly. Minimizing the need for such roadways in mountain areas by using alternate land use designs can often avoid such erosional hazards and cost much less to construct.

B. LIMITATIONS

Soils information sufficiently detailed to allow the preparation of specific landuse planning proposals is a critically important need in Tulare County. A modern, detailed soil survey with interpretive analysis of soil factors for non-agricultural use is needed. Detailed soil surveys of Tulare County compiled in two reports published in 1940 and 1942 (R. Earl Storie, Project Director) were the last two such reports prepared. These reports need to be updated to provide interpretive analysis for modern non-agricultural uses. Some technical adjustments such as the elimination of certain names not now used in the National Soil Classification System are also needed. The earlier soils identification programs in the "Storie" reports were mapped at a scale of 1 inch = 1 mile. Soil scientists have found that such large scale maps are somewhat difficult to use for modern management or planning of land uses. Most of the more recent detailed soil mapping has been done on aerial photos of a scale of 1 inch = 2,000 feet (1:24,000) or less.

A large part of the factual material, soil descriptions, and maps provided in this plan element is taken from a general map and soil survey of the County published in 1967. Although the 1967 report is considered accurate for the scale and intensity of investigation then undertaken, it should not be used as a basis for precise planning decisions unless additional field work is done. This is because the report groups soil types into larger associations based upon generally similar characteristics. The mapping at a scale of 1 inch = 2 miles is highly generalized and is not suitable for detailed evaluation of specific projects. In such cases, it is necessary to do additional field work and analysis. Thus, at most, the 1967 report is useful as an indicator of general soil conditions that would be expected in a given area. The maps and soil description of this plan element are, therefore, suitable for general and conceptual planning activities. Specific plan proposals may require on-site soil samples before decisions are made. (See Section 7063.2, Tulare County Ordinance Code, requiring geologic-hydrologic reports.)

Another factor which limits the use of soil survey information is that subsoil conditions below a depth of five feet are rarely considered. A full picture of the physical characteristics of the subsurface cannot be gained from a soil survey. This deficiency limits the use of soil surveys in evaluating the geological-hydrological characteristics of a given area.

Another limitation is found in the difficulties inherent in mapping soils (see next section for further information). The boundaries between different soil types in nature are rarely exact or precise. Furthermore, it is simply not physically possible to take soil samples on every piece of ground in the County. Soil scientists must, therefore, rely upon aerial photo analytical techniques correlated with field samples to map the distribution of soils. A certain factor for error must be accepted and special, localized studies of soils and geological factors made relative to proposed uses.

For these reasons, both detailed and general soil surveys should not take the place of precise hydrologic-geologic studies required for subdivisions and parcel maps. Because this plan element is largely based upon generalized information, the policies and recommendations herein are also general in nature.

Incomplete coverage of the County by existing soil surveys is another problem. The "Storie" reports cover only the valley portion of the County, bounded by the base of the foothills on the east. The 1967 survey includes the same area plus the foothills up to the Forest Service Boundary and National Parks. The Federal lands of the County have never undergone a soils survey.

C. SOIL CLASSIFICATION SYSTEMS

Soil classification systems are the fundamental tools for developing a system of soil management principles for land use. The complexity of soils throughout the County mandates that a systematic program of soil identification and classification be devised. Within a soil classification system, individual soils having similar properties or characteristics are grouped together so that they may be more easily studied and understood.

Soils are classified and named in the same manner as plants and animals are classified and named. Soils are identified by such characteristics as the kinds and numbers of horizons, or layers, that have developed in them. The texture (the relative amounts of stones, gravel, sand, silt, and clay), amount of organic material, the kinds of minerals present and their amounts, and the presence of salts and alkali help distinguish the horizons.

Depending upon the type of classification system, each grouping of soils should have similar behavioral responses or characteristics relating to the intended use of the system. This allows planners, engineers and architects to predict soil behavior when soils of a particular classification or type are put to certain uses.

If they know the effect of a given type of use in an area where the soil type has been identified, they can foresee the effect of that use in other areas with the same kind of soil.

Soils classification, thus, is essentially an inference of expected behavior deduced from interpretation of factual information and past experience, which must be constantly re-evaluated and updated. A good classification system is mapable, meaningful, and relates to those characteristics of soil that are of interest to the user.

The principle difficulty in classifying soils arises from the fact that soil varies within any area shown as one body or unit on a soil map. Some of this variation is deliberately allowed by soil scientists, some is not. Map units are allowed to encompass a (generally narrow) range in soil conditions because it is obviously impossible to set up absolutely homogeneous units and show them on a map at a reasonable scale. In nearly every map unit there are also small areas (called inclusions) with soil conditions other than those described for the map unit. Fortunately, these included soils will usually respond to a given land use in the same way as will the dominant soil in the map unit.

There are three soil classification systems that are used by planners, engineers, architects and builders in determining soil suitability for urban use. These consist of the comprehensive classification system utilized by U. S. Department of Agriculture, Soil Conservation Service (herein referred to as the USDA system), the American Associations of State Highway Officials (AASHO) system and the U. S. Army Corps of Engineers (Unified) system.

The USDA system is basically the same system that is recognized and used worldwide for agricultural application, and more recently for urban applications. The second two systems are more limited and specialized in scope and are used primarily in engineering applications.

C-1 USDA SYSTEM

Two systems of classifying soils have been used by the United States Department of Agriculture in recent years. The older system was adopted in 1938 and later revised. The system currently used by USDA was adopted for general use by the National Cooperative Soil Survey in 1965.*

The current USDA soil classification system is the most important of the three systems in common use today since it can be used as a basis for the ready and widespread application of the other two. It is known as a pedological** system since it has its foundation in the study of the external and internal characteristics of the soils themselves rather than, as do the other systems, in the application of soils to specific uses. It identifies soils not only according to such physical characteristics as color, texture, structure, permeability, and reaction but also according to such characteristics as parent material, positions in the landscape, slope, depth and drainage. In effect, the USDA system attempts to identify each significantly different soil as it occurs in the landscape. It assumes that soils having developed under similar soil-forming factors (climate, biological activity, parent material, topography and time) will behave similarly under specific uses wherever found.

*NOTE: The most current detailed soil surveys undertaken in Tulare County (Visalia Area 1940 and Pixley Area 1942) were based upon the older classification system.)

**Pedological: of or relating to soil science.

The classes in the current USDA system are briefly defined in the paragraphs that follow. The system is organized as a hierarchy with "*orders*" being the most generalized grouping and "*series*" being the most precise grouping.

ORDERS: Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. Broad climatic areas are the basic determinants of soil orders, the exceptions being Entisols and Histosols which occur in many different climates.

SUBORDERS: Each order is divided into suborders, primarily on the basis of soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders have a narrower climatic range than the orders. The criteria for suborders are chiefly chemical or physical properties that reflect the presence or absence of waterlogging, or soil differences resulting from the climate and vegetation.

GREAT GROUPS: Each suborder is further divided into great groups according to the presence or absence of certain significant genetic horizons, certain significant properties of these horizons, if present, or certain significant soil properties at specified depths.

SUBGROUPS: Each great group is subdivided into subgroups. One of these subgroups represents the central (*typic*) segment of the group, and the others, called *intergrades*, contain those soils having some properties of soils in another group, suborder, or order.

FAMILIES: Each subgroup is subdivided into families, primarily on the basis of properties important to the growth of plants but also relevant to the behavior of soils used in other ways. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, consistence, and thickness of specified horizons or defined layers.

SERIES: The series consists of a group of soils that formed from a particular kind of parent material and has genetic horizons that, except for texture of the surface soils, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, structure, reaction, consistence, and mineralogical and chemical composition.

TYPE: The type is the smallest unit in the classification of soils. One or a few types constitute a soil series. These are the common classification units seen on soil maps and survey reports. The soil type, a subdivision of the soil series, is based on the texture of the surface soil (stones, gravel, sand, silt and clay).

PHASE: The soil phase is not a part of the classification hierarchy. It is used to define certain characteristics of the soil type, series or one of the higher units in the system. Phases generally reflect differences in slope, degree of erosion, and stoniness. Other bases for defining phases include drainage and flood potential and the presence of contrasting layers below the soil.

Because the type and phase are the two most detailed classifications, these are generally the only two classifications of direct concern to planners and engineers. This is because precise definitions of soil variations are generally most meaningful for precise planning and engineering purposes. For general planning work, "associations" of soil series usually provide a more workable unit of classification. Soil associations are based upon properties or qualities of major importance to use and management, and thus form a firm basis for planning policy decisions. Generalized descriptions of each association found in the County and a map showing the spatial relationships of each association are in Chapter V.

One limitation of the USDA system is that the soil classifications are based solely upon the top five feet of the profile. The characteristics of the material underlying the first five feet is not considered and, thus, the underlying geologic characteristics are often unknown. This limits effectiveness of the USDA system in identifying potential geological or hydrological problems which may exist below the soil mantle.

The USDA system thus identifies and classifies soils according to all the important factors that relate to the top five feet of the soil mantle. The USDA system can be widely extended as engineering properties are determined for a particular soil type. Behavior of a soil can be accurately predicted from actual experience with the behavior of similar soils under actual use in the landscape elsewhere. The pedological approach incorporated in the USDA system provides a systematic approach to understanding land forms and their composition while providing the user with the most reasonably accurate representation of subsurface conditions. It enables planners and engineers to visualize corrective measures which may be necessary to provide the most practical economical solution to soil problems.

C-2 AASHO SYSTEM

The AASHO (American Association of State Highway Officials) System of classifying soils, the most widely known and used in highway practice, is an engineering property classification based on field performance of highways. This system became a standard of AASHO in 1945.

In this system soil material is classified in seven principal groups based upon similar *load carrying capacities and service characteristics*. Hence, if the AASHO soil group is the only fact known about a soil, only the broad limits of load-carrying capacity can be stated. The groups range from A-1 (gravelly soils having high bearing capacity) which are the best soils for subgrade, to A-7 (clayey soils having low strength when wet), which are the poorest soils for subgrade. Each group is differentiated from another group only by the ratio of the fine, medium and coarse textured particles in the soil.

Members of each group have similar broad characteristics in common. However, there is a wide range in the load-carrying capacity of each group as well as an overlapping of load-carrying capacity in the groups. Within each group the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best materials, to 20 for the poorest. Increasing values of the index number reflect a reduction in load-carrying capacity and the combined effect of an increasing liquid limit and plasticity index and of the increasing percentages of coarse material. Table No. 1 indicates the general criteria used to rate soils as subgrade under the AASHO system.

TABLE 1

Classification of Soils and Soil Aggregate Mixtures

AASHO SYSTEM

General Classification											
Group Classification	A-1-a	A-1-b	A-3	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5 A-7-6
Sieve Analysis, Percent passing:											
No. 10	50 max	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
No. 40	30 max	50 max	51 max	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
No. 200	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of Fraction passing No. 40:											
Liquid limit	- - -	- - -	- - -	40 max	41 max	40 max	41 max	40 max	41 min	40 max	41 min
Plasticity index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min
Usual Types of Significant Constituent Materials	Stone Fragments, Gravel and Sand		Fine Sand	Silty or Clayer Gravel and Sand				Silty Soils		Clayer Soils	
General Rating as Subgrade	Excellent to Good							Fair to Poor			

Plasticity index of A-7-5 subgroup is equal to or less than LL minus 30. Plasticity index of A-7-6 subgroup is greater than LL Minus 30.

Source: AASHO Designation: M 145-66 I in Interim Specifications and Methods Adopted by the AASHO Committee on Materials 1966-1967, published by the American Association of State Highway Officials in 1968.

C-3 UNIFIED SYSTEM

The Unified System of soil classification was developed for the U. S. Army Corps of Engineers, during World War II and subsequently expanded in cooperation with the U. S. Department of the Interior, Bureau of Reclamation, for application to embankment and foundation construction, for water retention structures as well as to roadway and airfield construction.

Like the AASHO System, the Unified Soil Classification System identifies soils according to their *textural and plasticity qualities* and their grouping with respect to their *performances as engineering construction materials.*

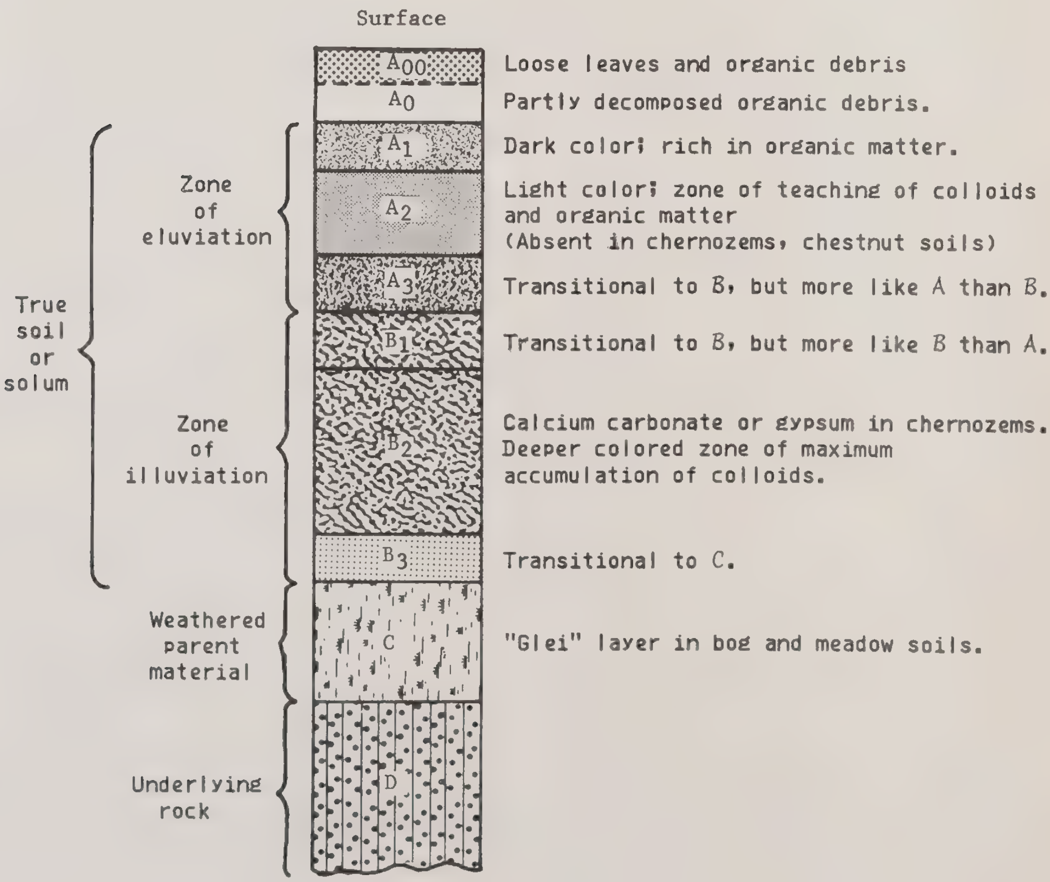
In this system soil materials are identified as coarse grained (eight classes), fine grained (six classes) and highly organic. Each soil is given a descriptive name and a letter symbol. For example, the symbols GM, GC, SM, and SC represent gravel or sand with fines of silt and clay; ML and CL, silt and clay of low liquid limit; CH and MH, silt and clay of high liquid limit; and GP, GM, SP, and SM, - sand, gravel, and mixtures of gravel and sand. Some soil materials have characteristics that are borderline between the major classes and are given a borderline classification, such as CL-ML.

These symbols are connotative of the soil make-up. For example, G classification contains gravels which are dominant in the make-up; O, organic matter influences its make-up, and the H classification signifies a high plasticity when moist.

A great advantage of this system is that a soil can be classified readily by visual and manual examination.

FIGURE 1

HORIZONS OF THE SOIL PROFILE



SOURCE: U.S.D.A., Soil Conservation Service

Prepared By Tulare County Department

Chapter IV

Soil Characteristics

CHAPTER IV

SOIL CHARACTERISTICS

Introduction

In order to efficiently carry out a comprehensive planning program, it must be recognized that soil behavior represents a basic determinant in the growth and development of the County. Any one of the millions of individual soils has a complex combination of many properties which cause separate soils to respond differently to given treatment and use. Intelligent decisions regarding the growth and development of the community require a precise knowledge of soil characteristics and limitations.

What are the characteristics of soils that need to be known in order to properly proceed with the planning process? The ensuing chapter provides a summary of those physical properties of soils which are of concern to planners, developers and administrators. For convenience, the descriptions of these basic soil characteristics are arranged under three subject headings: *Topographical* related characteristics, *Water* related characteristics and *Inherent* characteristics of the soil.

However, before proceeding further, it is necessary to lay some basic groundwork about soils in general.

What Soils Are

A "soil", as the term is used in soil science classification, is an individual body on the surface of the earth. It has depth and shape and its boundaries are also the boundaries of other soils. These boundaries come at places where one or more of the basic soil-forming factors change or have been unlike at some previous time during the genesis of the soil. These basic factors are:

Climate
Biological activity
Parent Material
Topography
Time

The soil mantle of the earth is far from uniform, but all soils have some things in common.

1. Every soil consists of mineral and organic matter, water and air. The proportions vary, but the major components remain the same.
2. Every soil occupies space. As a small segment of the earth, it extends down into the planet as well as over its surface.
3. Every soil has a profile -- a succession of layers in a vertical section down into loose weathered rock. The nature of the soil profile has a lot to do with the plant growth, the storage of moisture, and the supplies of plant nutrients. The profile also is basic to scientific studies of soil.

A SOIL PROFILE consists of two or more layers lying one below the other and parallel to the land surface. The layers are known as horizons. The horizons differ in one or more properties such as color, texture, structure, consistence, porosity, and reaction.

Most soil profiles include three master horizons identified by the letters A, B, and C.

The combined A and B horizons are called the *solum*, sometimes the "true soil". Together they form the major part of a profile. They are also direct results of the processes by which soils are formed. All of the master horizons may be subdivided in the scientific study of soils. The subdivisions of master horizons provide clues to the processes of soil formation and are important to the use and management of soils (See Figure 1). All of the horizons and subhorizons in the profile do not exist in any actual soil. Yet some of the horizons are part of every soil on earth.

The A horizon, the uppermost layer in the soil profile, often is called the surface soil. It is the part of the soil in which life is most abundant in such forms as plant roots, bacteria, fungi, and small animals. It is therefore the part in which organic matter is most plentiful.

The B horizon lies immediately beneath the A horizon and often is called the subsoil. Lying between the A and C horizons, it partakes of the properties of both. Living organisms are fewer than in the A horizon but more abundant than in the C horizon. The B horizon generally is harder when dry and is frequently higher in clay than the A and C horizons. Concentrations of iron oxide or aluminum oxides in the form of hardpans, mark B horizons of some soils.

The C horizon is the deepest of the three major horizons. It consists of the upper part of the loose and partly decayed rock beneath the A and B horizons. The C horizon is said to be the weathered parent material of soils. It may have accumulated in place, or it may have been transported to where it now is by natural forces. The C horizon has less living matter than overlying ones and is therefore lower in organic matter.

A. TOPOGRAPHICAL RELATED CHARACTERISTICS

A-1 SLOPE

Topography profoundly affects the development of a mature soil profile. On steep slopes the profile may never mature because surface runoff removes weathering products as quickly as they are formed. In general, the steeper the slope, the faster is the flow and the more intense the erosion. The eroding capacity of overland flow increases directly with angle of slope. As the slope angle approaches the vertical, however, erosion will become less intense from overland flow because the ground surface intercepts much less of the vertically falling rain. Thus, on steep slopes thinner soils are normally found, in which one or more of the upper soil horizons have been removed -- if they were ever present.

Topography also affects the amount of water penetrating the soil due to the gravitational pull of water down-slope where it meets less resistance. The configuration of the topography also serves to control and channelize surface runoff. It further influences the position of the water table and thereby the depth of penetration of most chemical weathering processes in soil formation. The amount of relief governs the circulation of water through the soil and parent material, and thus determines whether the soil profile develops under conditions of good or poor drainage.

Another influence of landform is the slope aspect or direction of exposure of the surface to the slanting rays of the sun. This aspect of slopes has a direct influence upon plants and soil formation by increasing or decreasing the exposure to sunlight, heat and to prevailing winds. Slopes facing the sun have a warmer, drier environment than slopes facing away from the sun and, therefore, lying in shade for much longer periods of the day. In Tulare County, these slope-aspect contrasts may be so strong as to produce quite different plant formations and soil types on north-facing and south-facing slopes.

Obviously, as slopes become steeper, the soil mantle becomes thinner and more fragile. In the foothills of the Sierra Nevada, for example, there are numerous examples of unstable soil types which have formed on steep terrain. A specific example would be those soils developed from serpentine parent material. Although these soils are fertile, they are highly unstable and susceptible to erosion or mass slippage when disturbed. They are invariably found in steeply sloping topography and are subject to creep and sliding when wet or saturated.

A-2 EROSION

Geologists have identified at least five major types of erosional agents constantly and universally at work in nature; these consist of: running water, groundwater, waves and currents, wind, and glaciers. For the purpose of this study, however, the basic concern is with the erosional characteristics and processes associated with wind and running water. Furthermore, since those erosional processes associated with wind and flooding are more fully covered in other sections of this report, the scope of this section is limited to the effects of overland flow on sloping topography.

Overland flow causes erosion by exerting a dragging force over the soil surface which enables it to sweep away loose materials. Depending on the speed of the flow and the degree to which the soil is held together or protected by vegetation, overland flow can pick up almost any size particle. Overland flow may also carry dissolved mineral matter produced by soil reactions or direct solutions. This erosional process is a natural phenomena which under undisturbed conditions, usually does not occur rapidly enough to prevent the formation of a mature soil profile; thus, the protective vegetation cover is allowed to maintain itself.

Man's activities and certain kinds of natural events (i.e., fire) can serve to speed up the rate of soil erosion until it exceeds the rate of soil formation. This process is termed "accelerated erosion". The processes associated with accelerated erosion, can be explained in terms of the interrelated function of the vegetative cover and the physical state of the ground surface (which, under natural conditions, would normally prevent the occurrence of accelerated erosion).

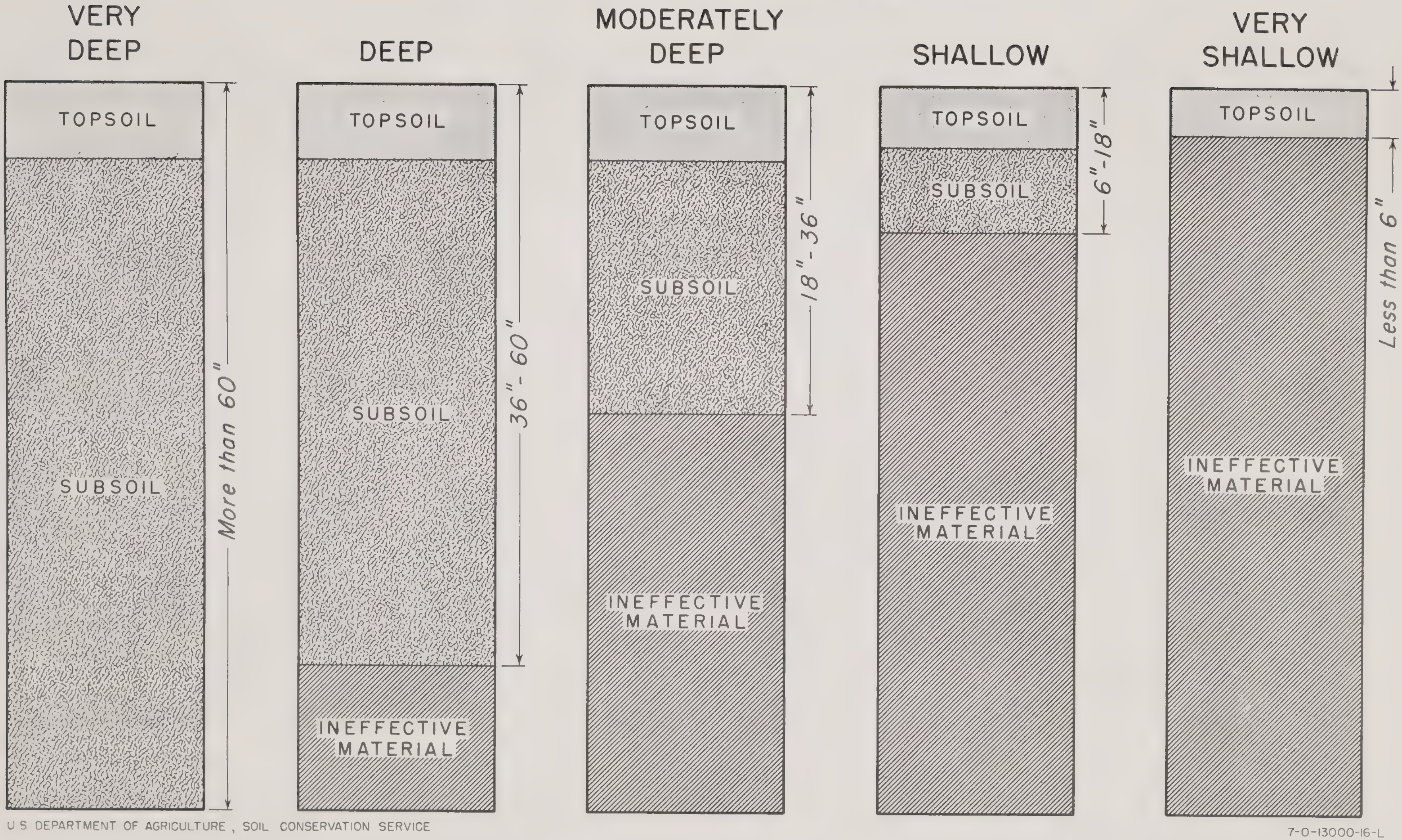
Under natural conditions, overland flow resulting from rainfall is delayed somewhat, even under heavy rainfall. The delaying processes are described as follows:

1. A forest canopy or vegetative cover will intercept much of the rainfall before it reaches the soil and return it to the atmosphere by evaporation or allow its slow passage to the earth below.

2. Most ground surfaces are capable of absorbing even a heavy rainfall in its early stages until the soil passages are sealed and the soil becomes saturated.

Figure 2

SOIL DEPTH



Source: USDA Soil Conservation Service

3. After the soil becomes saturated, for a time the water which accumulates on the surface is detained on the slopes by such obstructions as fallen leaves, twigs and the vegetative cover itself.

Overland flow will not occur until these delaying actions inherent in nature are overcome by a heavy rainfall. Thus, the erosional process caused by overland flow is normally delayed on most sloping topography. Even after overland flow has begun, the energy of the moving water is greatly dissipated in friction with the protective vegetation and the detention structures described in (3) above. Furthermore, if the soil is heavily matted by fallen leaves or tightly secured by the intricate root systems of plants, very little erosion would be expected to occur.

In contrast, if the vegetation is removed or destroyed by either fire or the acts of man, interception by foliage is ended; surface detention by vegetation is eliminated and consequently, rain falls directly upon the soil surface. Obviously, without the delaying devices, water begins to flow downslope much more quickly than before. Also, without the protective stability offered by fallen leaves and roots, the soil is much more susceptible to the hydraulic action of water. When these conditions occur, erosion is said to have become "accelerated".

There are several forms of accelerated erosion which are best described according to the degree of severity of the erosive processes. Beginning with the least severe, the four basic forms of accelerated erosion by overland flow are as follows:

Splash erosion - This term applies to force exerted by falling drops of water upon an unprotected soil surface. This action produces a rearrangement of soil particles which, on sloping topography, tends to shift the soil slowly downhill. The most significant effect of splash erosion is to make the surface of the soil less permeable. This is because the natural soil openings become clogged with particles rearranged by the force exerted by the impact. This, in turn, increases the amount of water flowing overland which would otherwise infiltrate the soil. It has been estimated that upward of 100 tons of soil per acre can be disturbed by splash erosion during especially concentrated rainfall.

Sheet erosion - Sheet erosion refers to the removal of soils in thin, usually uniform layers by the force of overland flow. Generally, this form of erosion occurs on gentle sloping topography, where the soil may be exposed or unprotected. Evidence of sheet erosion can be observed at the base of the slope by the collection or deposition of sheets of colluvium.*

Rill or Gully erosion - On more steeply sloping topography, sheet erosion will quickly evolve into a more intense activity known as rill or gully erosion. Here the erosion is so intense that channels become scoured into the soil and subsoil.

Badlands - If continued unchecked, rill and gully erosion will eventually remove all the original soil mantle rendering the land into the category of badlands. This is a rugged, barren topography, wholely or nearly devoid of vegetation and utterly worthless for agricultural or any other use.

It is, perhaps, necessary at this point to concede that this discussion of erosion has been simplified somewhat in order to clarify the cause-effect relationships. Certainly it is true that different soils derived from different parent materials will weather differently under similar conditions. Most granitic soils, for example, are quite susceptible to erosion whereas metamorphic soils, in general, are resistant to erosion.

Also, it should be noted that the degree of steepness of the topography controls, to a great extent, the velocity at which water moves over the land. The velocity of the moving water profoundly influences the erosive force of overland flow. Thus, as a general rule, soils on steeply sloping topography are more susceptible to accelerated erosion than similar soils on gentle slopes.

In general, therefore, the risk of erosion depends upon texture, structure, degree of slope, vegetative cover, parent material, and runoff potential. Soil scientists define soil hazard as an estimate of the degree of erosion to be expected if the soil is left finely tilled or if protective vegetative cover is removed by fire or other means before the rainy season.

(See pages 67 and 68 for illustrations of local erosion problems).

*Colluvium: Rock and soil accumulated at the foot of a slope.

The soil limitation** ratings are as follows:

Degree of Limitation

None - Soils having slopes less than 2% and moderately rapid to rapid subsoil permeability.

Slight - Soils having slopes of 2 - 9%; moderate to moderately rapid subsoil permeability; weak or shallow profile development.

Moderate - Soils having little to no profile development on slopes of 9 to 30%; or, soils having moderate profile development on slopes of 9 to 15%.

High - Soils having little or no profile development on slopes of 30 to 50%; or, soils with moderate to strong profile development on slopes of 15 to 30%.

Very High - Soils having no profile development on slopes in excess of 50%; or, soils having moderate to strong profile development on slopes in excess of 30%.

The map on the following page indicates the potential for accelerated erosion in Tulare County based upon the 1967 General Soil Survey.

A-3 MASS MOVEMENT

Mass movement refers to the gravitative transfer of materials, sometimes called mass-wasting. It is characterized by such processes as: soil creep, mud flows, earthflows, slump, landslides and subsidence.

Basically, the primary motivator of mass movement is gravity. However, gravity can move material only when it is able to overcome the material's internal resistance against being set into motion. The addition of water to the soil is the primary factor which augments gravity and influences mass movement. Oversaturation tends to reduce the surface tension between particles in the soil and decrease the internal friction or resistance of the soil to movement. The presence of water also adds weight to the soil on a slope and may, in some cases, act as a "lubricant" between the soil mantle and bedrock.

Water, however, is not the only cause of mass movement. Any sloping topography can be subject to mass movement when the material's internal resistance to gravity is overcome. Thus, any factor that reduces this gravitative resistance contributes to mass movement. The impetus needed to initiate movement can take many forms: the erosive action of streams and surface water; the unstabling effects of earthquakes; and the various acts of man which disturb or alter slope stability.

A few of the more common types of mass movements which can be identified in the foothills and mountainous areas of Tulare County are described here.

Soil creep - Creep is a slow, downward movement of surface materials which can occur on any steepness of slope, even with a protective vegetative cover. To the observer, it is often difficult to realize that this movement is actually taking place. Yet this movement can be easily demonstrated by tilted fence posts and telephone poles, crumbling retaining walls, stretched out layers of weathered rock in gullies and roadcuts, and by the behavior of tree roots. Generally, any process which rearranges or disturbs the soil mantel on slopes serves to encourage soil creep. This is because the soil particles undergoing rearrangement are progressively urged downhill by the pull of gravity. Common causes of such rearrangement include: alternate heating and cooling of the soil, frost action, the trampling and burrowing of animals, earthquakes and explosions, and alternate drying and wetting of the soil.

Earthflow and Slump - These terms are used to describe the relatively slow downward and outward movement of rock or unconsolidated material. Slump is used to describe this movement when it occurs as a unit or as a series of units. On the other hand, earthflows are a combination of slump and the plastic movement of unconsolidated material. Both phenomena are largely created when soils on steep slopes become highly saturated with water. This type of movement is further encouraged by the undercutting of otherwise stable slopes by natural or accelerated erosion, or by removal of materials by man. Slumping commonly occurs on a small scale whereever soil mantle materials are cut away and, hence, is often seen along mountain roads and along river banks.

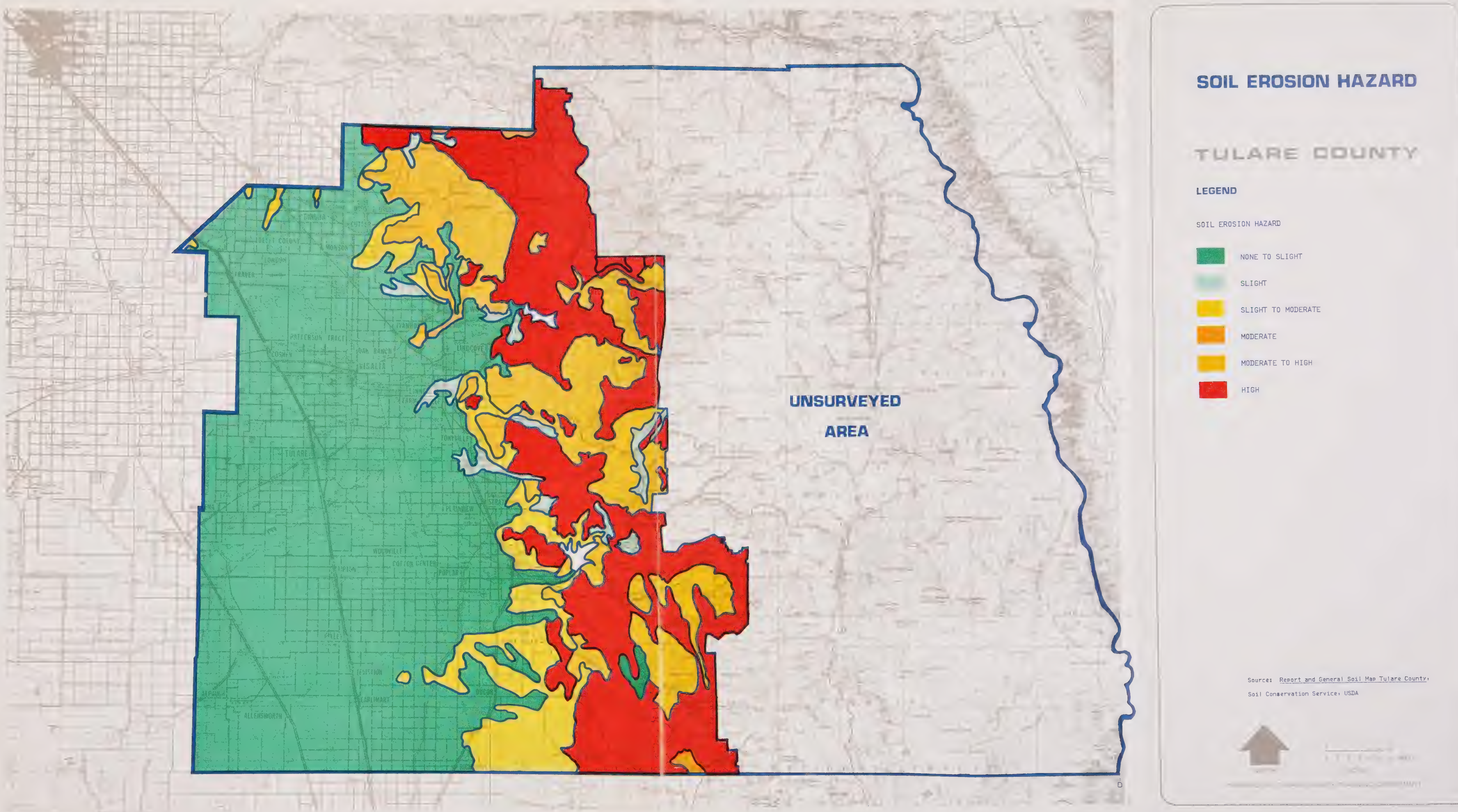
**Detailed definitions of the terms used in defining the degree of limitations are found on page   of Chapter VI.

SOIL EROSION HAZARDS

Obviously the velocity at which water moves over the land is primarily a function of degree of slope. Since the velocity of moving water profoundly influences the erosive forces of overland flow, as a general rule, soils on steeply sloping topography are more susceptible to erosion than similar soils on more gentle slopes. This rule is illustrated on the accompanying map. The valley areas of the County have very little potential for erosion; while the foothills and mountainous areas of the County in certain areas have severe erosional hazards.

In addition to topography, the risk of erosion also depends upon texture, structure, vegetative cover, parent material, and runoff potential. The map indicates the degree of erosion that could be expected if the soil was left finely tilled or if protective vegetative cover was removed.

An evaluation of the potential for accelerated erosion is an important consideration in determining the appropriateness of an area for recreational development. The most critical impact on soils by development in mountainous areas occurs during the construction phases when the soils on the site may remain unprotected for long periods of time. In general, any soil formed on more than 12% slopes has the potential for severe erosional problems. Any soil with slopes of greater than 30% under any condition would have a high erosional potential.


SOIL EROSION HAZARD
TULARE COUNTY
LEGEND
SOIL EROSION HAZARD
NONE TO SLIGHT
SLIGHT
SLIGHT TO MODERATE
MODERATE
MODERATE TO HIGH
HIGH
UNSURVEYED AREA
Source: Report and General Soil Map Tulare County, Soil Conservation Service, USDA

Mudflow - Mudflows occur as quickly flowing streams of mud and rock caused by violent storms which produce rain much faster than it can be absorbed into the soil. Usually, slopes consisting of unconsolidated or unstable materials, or lacking vegetative cover are highly susceptible to mudflow. As the water flows downhill it quickly picks up debris and is gradually transformed into mud. Although in Tulare County this usually occurs infrequently and on a small scale, desert area mudflows sometimes are large enough to carry large boulders down gentle slopes.

Landslides - Wherever steep mountain slopes occur, there is a possibility of disastrous landslides or rockslides. Fortunately, their occurrence is somewhat more infrequent than slumping or soil creep. Most landslides are primarily the result of weak, underlying rock strata. However, man-made excavations in the building of dams, railways and highways may also undermine rock masses, or allow the introduction of water into previously dry strata, and cause sliding.

Subsidence - In contrast to other types of mass movement, subsidence involves a downward settling of materials with little horizontal movement along the surface of slopes. Subsidence is generally a man-caused phenomena although it can occur naturally. The principle natural causes include:

1. Underground solution or erosion of rocks.

2. Lateral flow of some earth materials (such as clay) under loading.

3. Compaction of sediments by loading, drainage, wetting or vibration.

4. Tectonic movements of the earth.

5. Volcanic activity.

Subsidence in the Central Valley is largely man-caused and principally occurs due to two directly related activities.

1. Distribution of extensive amounts of irrigation water into clay or fine textured soils where little water previously existed has been known to cause subsidence. This results in a reorientation of soil particles and eventual collapse of sedimentary structure. This process has caused land to subside as much as 10 to 15 feet in parts of the San Joaquin Valley.

2. Subsidence resulting from intensive pumping of groundwater is a widespread phenomena. This type of subsidence is partly due to the relatively young geologic sedimentary structure of the Valley. Where substantial lowering of the water table has occurred in young, unconsolidated, compressible deposits that contain extensive semi-contained to contained aquifer systems, land subsidence has resulted. This process has served to lower much of the land in the southwestern corner of the County a foot or more during the last 20 years.

B. WATER RELATED CHARACTERISTICS

B-1 PERMEABILITY

Soil permeability or percolation is the ability of the soil to transmit water. It is usually expressed as a rate at which water may penetrate or pass through a soil mass or soil horizon. This characteristic is described in inches per hour, or the depth to which water will penetrate soil during an hour's time. The Soil Conservation Service utilizes a classification system to describe differing permeability rates:

Very slow	- Less than 0.05 inches per hour.
Slow	- 0.05 to 0.20 inches per hour.
Moderately slow	- 0.20 to 0.80 inches per hour.
Moderate	- 0.80 to 2.5 inches per hour.
Moderately rapid	- 2.5 to 5.0 inches per hour.
Rapid	- 5.0 to 10.0 inches per hour.
Very rapid	- More than 10.0 inches per hour.

Permeability rates are largely determined by the texture and porosity of the soil. All soils have natural passageways between poorly fitting soil particles, as well as larger openings, such as earth cracks resulting from soil drying, borings of worms and animals, cavities left from decay of plant roots, or openings made by heaving and collapse of soil as frost crystals alternately grow and melt.

Usually, coarse textured soils have a high porosity and thus have high rates of permeability. The size and continuity of the openings also influence permeability in an important way. The relationship between size of openings and the molecular attraction of soil surfaces plays a large part. Molecular attraction is the force that makes a thin coating of water adhere to a rock surface despite the force of gravity. If the open spaces between two adjacent grains is small enough, the films of water adhering to them will come into contact. This means that the force of molecular attraction extends right across the opening. At ordinary pressure, therefore, the water is held firmly in place and permeability is very low. This is what happens in clay, whose component grains are less than 0.005 mm in diameter.

By contrast, in a soil with grains at least as large as sand grains (0.06 to 2mm) the open spaces are wider than the films of water adhering to the grains. As the force of molecular attraction does not extend across them effectively, water in the centers of the openings is free to move in response to gravity. As the diameter of the openings between soil particles increases, permeability increases.

The identification of highly permeable soils can be used as a basis for locating aquifer recharge areas when the underlying geologic structure is known. A map showing aquifer recharge areas follows page 74 in Chapter VI.

B-2 DRAINAGE AND RUNOFF

Drainage and runoff are terms used to describe the rate or extent of removal of water from the soil. The type of drainage defined for a given soil is a function of several factors. These factors include: topography and slope, depth to the water table, depth to bedrock or impervious layer, texture, and porosity.

The Soil Conservation Service recognizes seven classes of soil drainage, as follows:

Very poorly drained - Water is removed from the soil so slowly that the water table remains at or near the surface the greater part of the time. Soils of this class usually occupy level or depressed sites and are frequently ponded.

Poorly drained - Water is removed from the soil so slowly that the soil remains wet for a large part of the time. The water table is commonly at or near the surface during a considerable part of the year.

Somewhat poorly drained - Water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time. Somewhat poorly drained soils commonly have a slowly permeable layer within the profile, a high water table, additions through seepage, or a combination of these conditions.

Moderately well drained - Water is removed from the soil somewhat slowly, so that the profile is wet for a small but significant part of the time. Moderately well drained soils commonly have a slowly permeable layer within or immediately beneath the *solum*, a relatively high water table, additions of water through seepage, or some combination of these conditions.

Well drained - Water is removed from the soil readily but not rapidly. Well drained soils are commonly intermediate in texture, although soils of other textural classes may also be well drained.

Somewhat excessively drained - Water is removed from the soil rapidly. Some soils are shallow, have little horizon differentiation, and are sandy or very porous.

Excessively drained - Water is removed from the soil very rapidly. Excessively drained soils are commonly shallow, steep, and very coarse or porous.

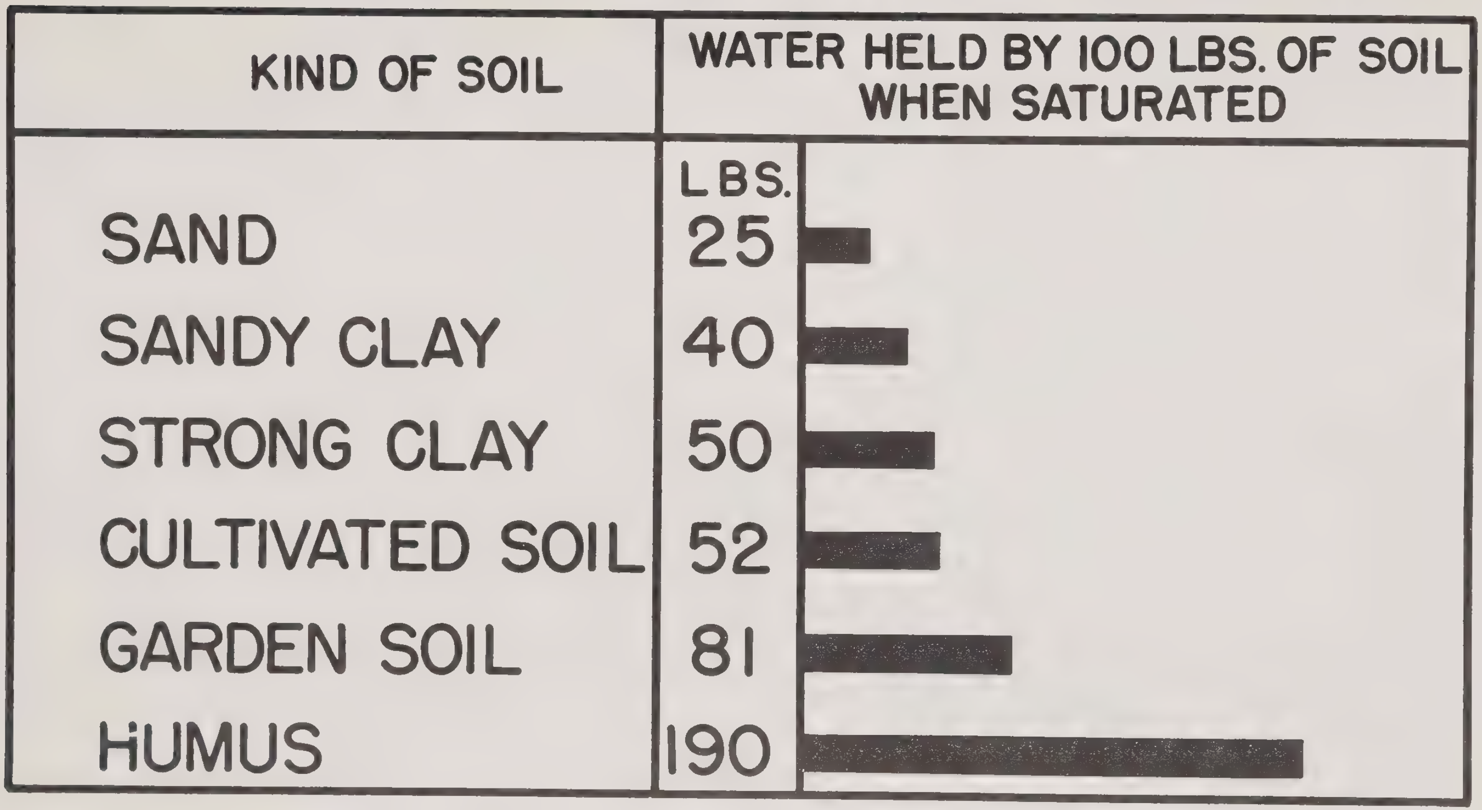
B-3 WATER TABLE

Groundwater is that water which accumulates beneath the surface of the earth contained in the pore spaces of rock or unconsolidated materials. Groundwater originates from, and is maintained by, the water that soaks into the earth percolating downward through the unconsolidated soil and mantle rock until a depth is reached where the density of the rock and the lack of crevices prohibit any further penetration. The greater portion of rock, porous enough to contain water, is usually within a few hundred feet of the surface. The upper limit of the soil or underlying rock material which is wholely saturated with water is known as the "water table".

M 1800-215 USDA SCS PORTLAND OREG

Figure 3

COMPARATIVE WATER-HOLDING POWERS OF SOILS



Soils vary greatly in their capacity to hold water. Humus greatly increases water-holding capacity

DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

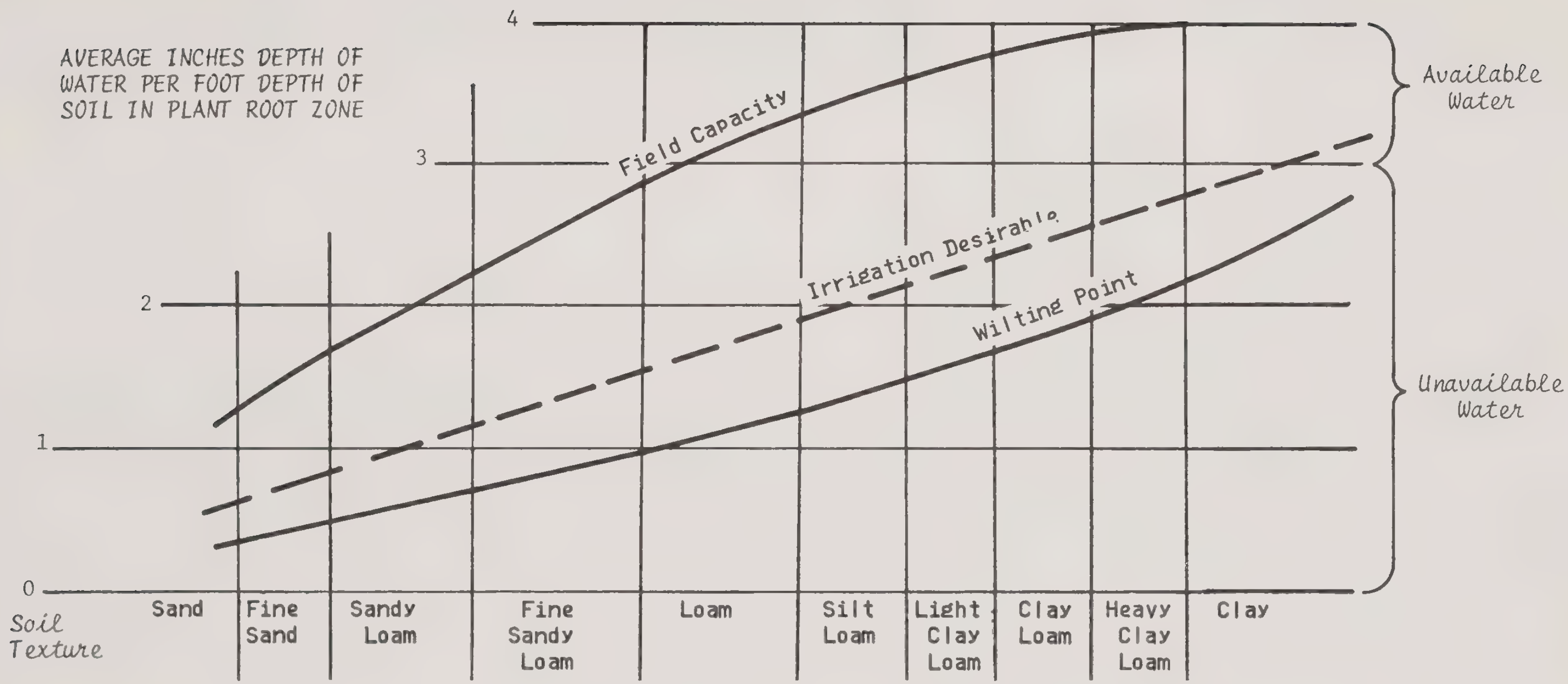
7-0-13000-215-L

Source: USDA Soil Conservation Service

Figure 4

TYPICAL WATER-HOLDING CAPACITIES OF DIFFERENT

TEXTURED SOILS

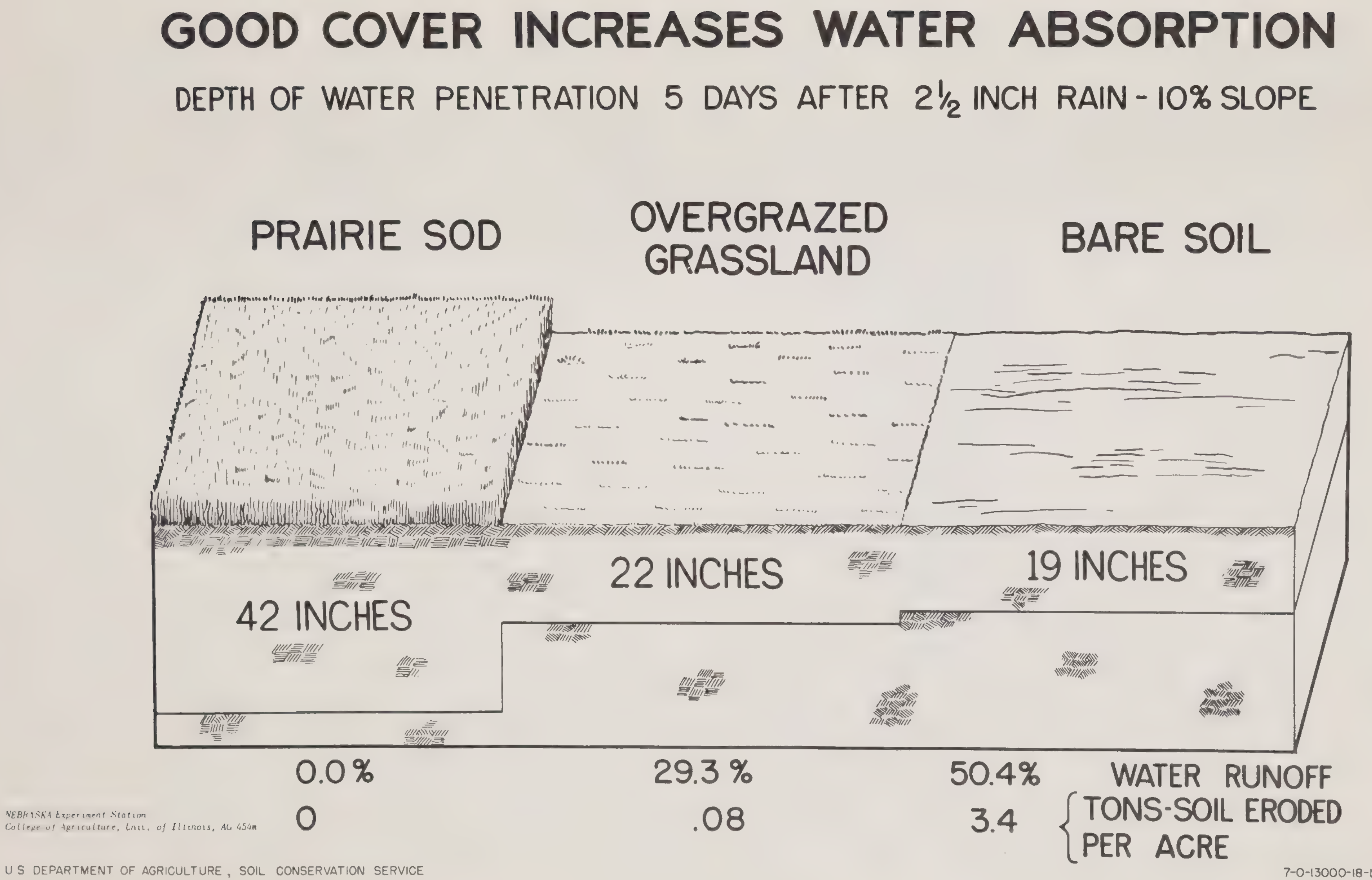


SOURCE: The Yearbook of Agriculture, 1955

Prepared By Tulare County Planning Department

M-1800-18 USDA SCS PORTLAND OREG 1957

Figure 5

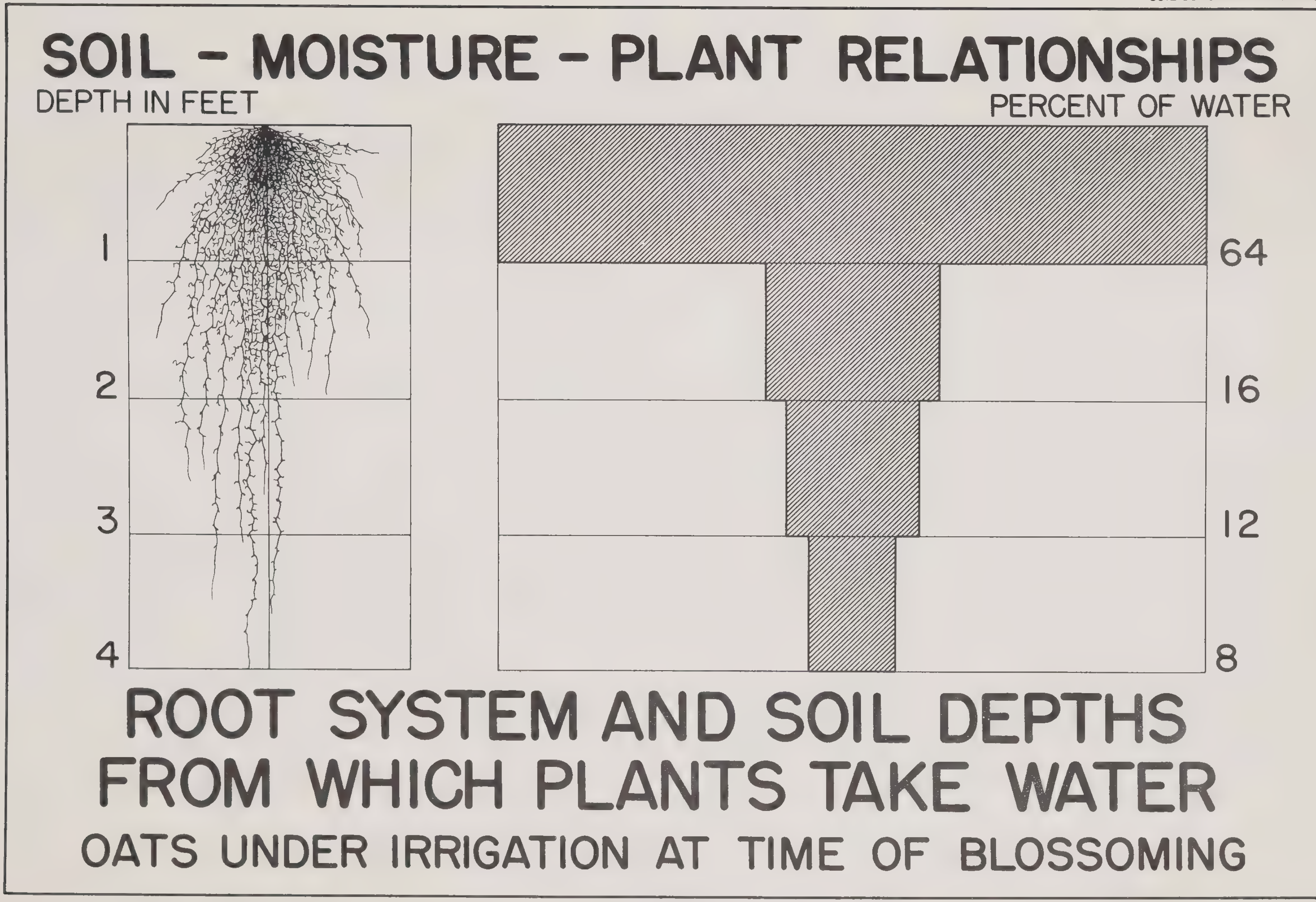


Source: USDA Soil Conservation Service

Figure 6

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



SOUTHWEST REGION

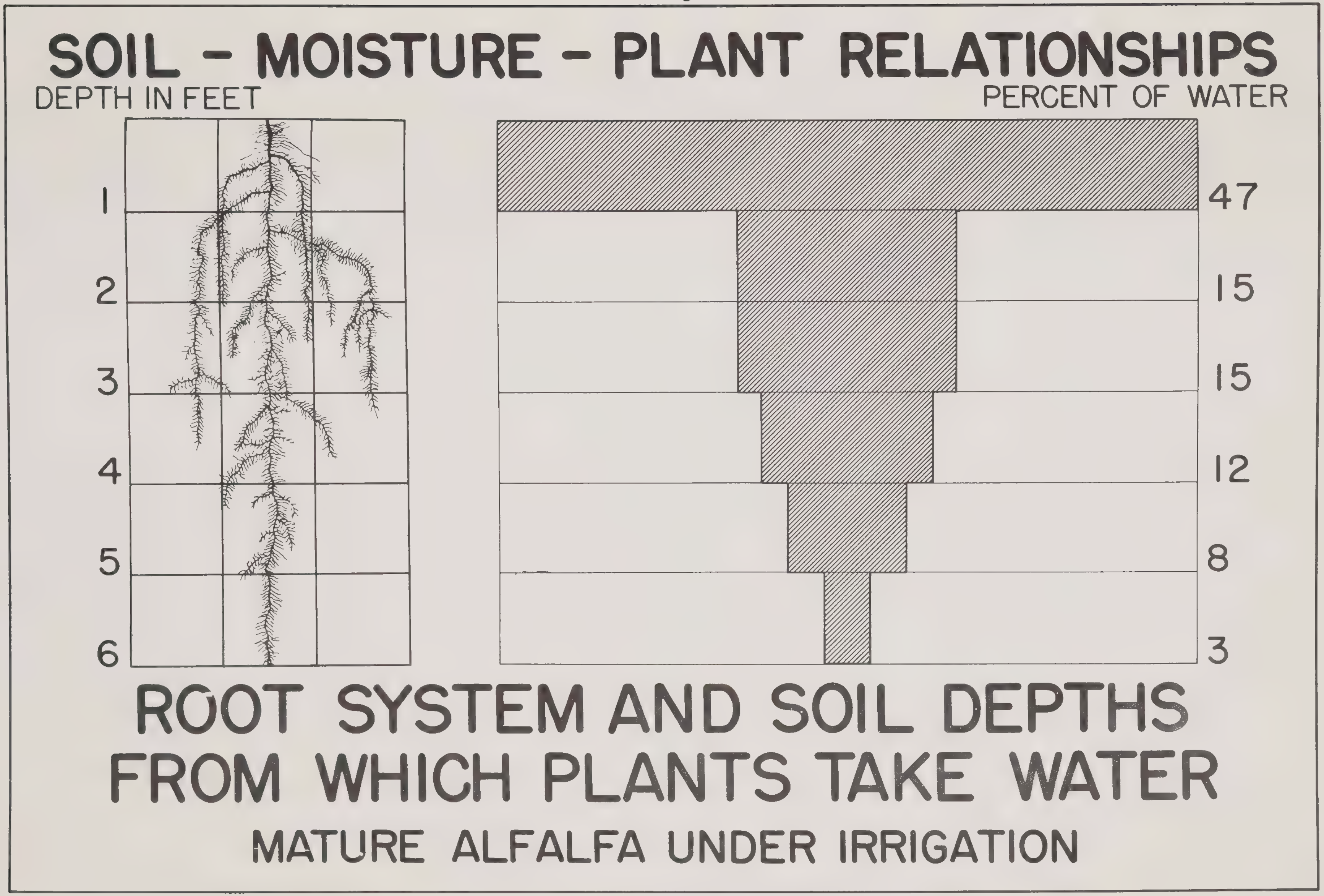
6-0-14019

Source: USDA Soil Conservation Service

UNITED STATES DEPARTMENT OF AGRICULTURE

Figure 7

SOIL CONSERVATION SERVICE



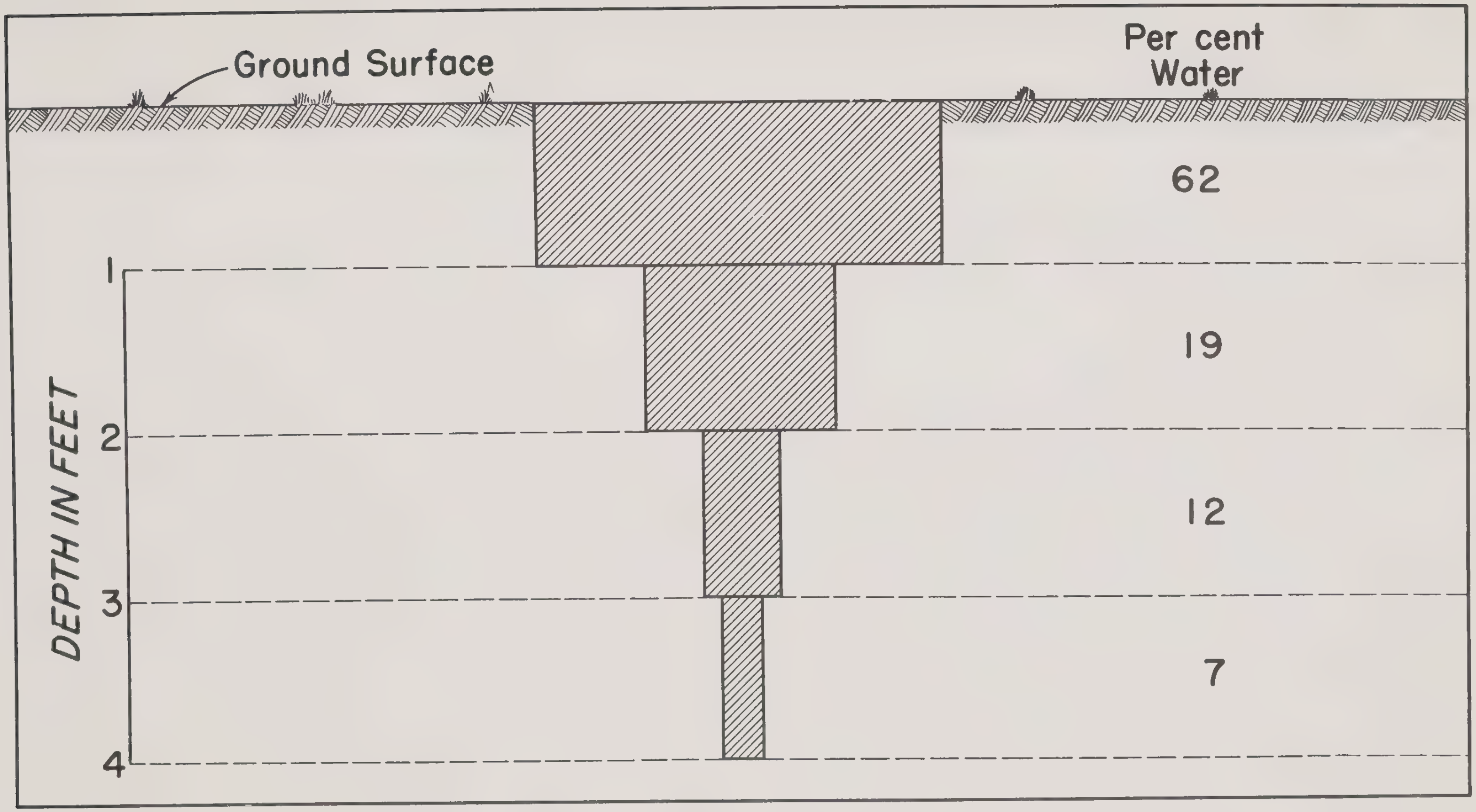
SOUTHWEST REGION

6-0-14021

Source: USDA Soil Conservation Service.

Figure 8

SOIL DEPTHS FROM WHICH WATER IS TAKEN BY SUGAR BEETS



Moisture depths-sugar beets

6-L-14003

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
H H BENNETT, Chief

PACIFIC REGION
J H CHRIST Director

Source: USDA Soil Conservation Service

The water table is not necessarily a horizontal surface, nor is it at a constant depth below the earth's surface. It is usually highest under the highest areas of surface, namely, hilltops and divides, but descends toward the valleys where it may appear at the surface close to streams, lakes, or marshes. The reason for such a configuration of the water table is that water percolating down through the soil mantle tends to raise the water table, whereas seepage into streams, swamps, and lakes tends to draw off groundwater and to lower its level.

In some areas an upper, or perched, water table may be separated from a lower water table by a dry zone. This happens when water seeping through the earth is caught in basins of impermeable material perched in positions higher than the main water table. Impermeable materials such as clay and rock substrata containing much clay are a common cause of perched water tables. Also, a temporarily perched water table frequently develops after heavy rains in soils underlain by hardpans. As this occurs near the soil surface, the existence of hardpans is a major consideration in evaluating soil drainage.

B-4 AVAILABLE WATER HOLDING CAPACITY

When infiltration occurs during heavy rains (or when snow is melting), the water is drawn downward by gravity through the soil pores, wetting successively lower layers. Soon all the soil openings are filled with water moving downward. Following the rainfall, the excess soil water continues to drain downward. However, some of the water clings to the soil particles and resists the pull of gravity through the force of capillary tension. This water, called soil water, will stay in the soil until disposed of by evaporation or by absorption into plant rootlets.

When a soil has first been saturated by water, then allowed to drain under gravity until no more water moves downward, the soil is said to be holding its *field capacity* of water. This process takes no more than two or three days for most soils. Field capacity is measured in inches per foot of soil material.

Field capacity of a given soil depends largely on its texture. Sandy soil has a very low field capacity, whereas clay soil has a high field capacity. This effect is shown in Figure 4 p16, a graph in which field capacity is plotted against soil texture, from coarse to fine. It should also be noted that sandy soils reach their field capacity very quickly, both because of the ease with which the water penetrates and the low quantity required. Clay soils take long rain periods to reach field capacity because the infiltration is slow and the total quantity required to be absorbed is great. Soil scientists also use a measure of soil moisture termed the *wilting point or wilting percentage*. This is the quantity of soil water below which plants will cease to grow. This water, called "unavailable water", is held so firmly by the soil that it cannot be absorbed by plants.

As Figure 4 shows, the wilting point also depends upon particle size. The soil water that is retained between the field capacity and the permanent wilting point is called "available water" in that it can be readily absorbed by plant roots. The capacity of the soil to retain available water is an important consideration in the rating of soils. It is generally expressed as a percentage of the dry weight of the soil.

B-5 FLOODING

Rivers come into existence as the result of precipitation falling on the land. Because the lands receive their precipitation at irregular intervals and because the amounts vary from place to place, the streams resulting from the runoff are markedly irregular in their discharge. An important proportion of the precipitation never becomes absorbed into the ground but flows quickly to the water courses.

A condition of flooding exists when the discharge of a river cannot be accommodated within the margins of its normal channel, so that the water spreads over adjoining ground. It is a rather commonly accepted fact that the condition of the soils and slopes in the drainage area of a stream can either retard or accelerate flooding conditions.

This is due to the fact that floods occur in part because the soil and soil material are unable to absorb precipitation as fast as it falls, or before it escapes as sheet-wash. In soils having high infiltration, floods seldom occur unless the ground is saturated or frozen, or the intensity is so great that excessive runoff results. Where the soil surface is clayey and more or less impervious to infiltration, the runoff will be heavy in all storms of great intensity.

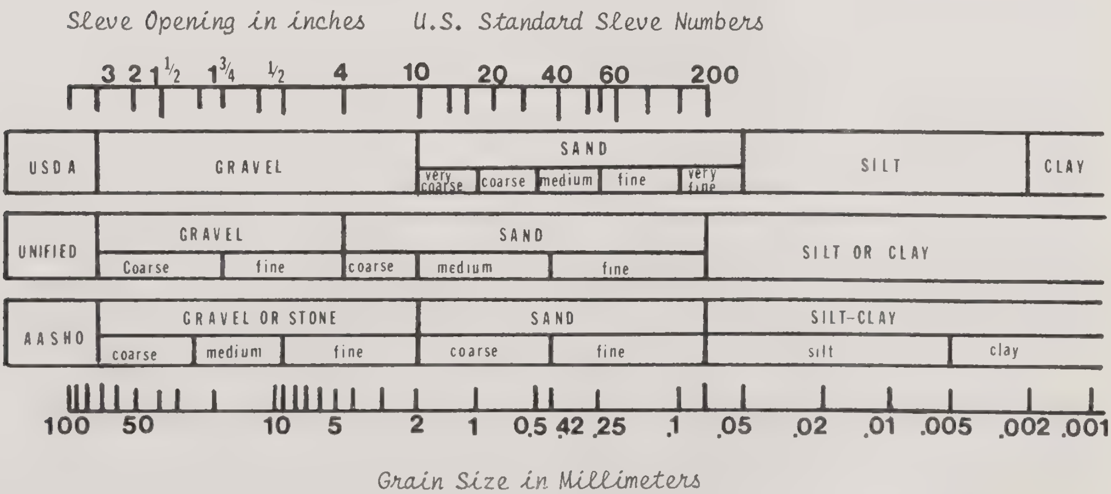
In regions of steep slopes, there is an accelerated streamward movement of overland flow unless precipitation is light enough to permit infiltration. In rugged areas with steep slopes, torrential rains are accompanied by rapid runoff and flooding of lowlands along watercourses. Heavy vegetation cover may somewhat reduce the runoff, and consequently the flood damage, but forested areas are not free from floods.

In Tulare County extensive flooding does not usually occur until the streams discharge onto the relatively flat valley floor. In the valley each field becomes, to a limited extent, a catchment basin, retarding the discharge of flood water to its ultimate destination. Water drains slowly from lands of low relief giving time for the stream to discharge its water continuously within its confining channel. The overland flow, sometimes referred to as sheet flow, may be delayed sufficiently to permit infiltration and groundwater recharge.

The effects of man in disturbing the topography and soils in an area generally are to accelerate overland flow and inhibit infiltration. The artificially improved drainage is conducive to rapid runoff and thus may result in erosion, flooding and the deposition of debris further downstream. The cumulative effects of extensive development or disturbance of watersheds in this way inevitably results in the intensification of flood potential.

Figure 9

COMPARISON OF PARTICLES SIZE SCALES



Soil texture is the principal characteristic that affects soil permeability. Similarly, the water-holding capacity of soil is controlled mainly by texture and the amount of organic matter present. The ability of soils to hold chemical elements that are used by plants in growth and reproduction is also a function of soil texture and organic matter content. In general, the fertility-holding capacity of soils is directly related to organic matter content and the amount of clay in the soil. The stability of soils when subjected to stationary or moving loads is also related mainly to soil texture. Furthermore, shrink-swell potential or the change of soil volume with changes in soil moisture is directly related to the amount and kind of clay in the soil.

Source: USDA Soil Conservation Service

C. CHARACTERISTICS INHERENT IN THE SOIL

C-1 TEXTURE

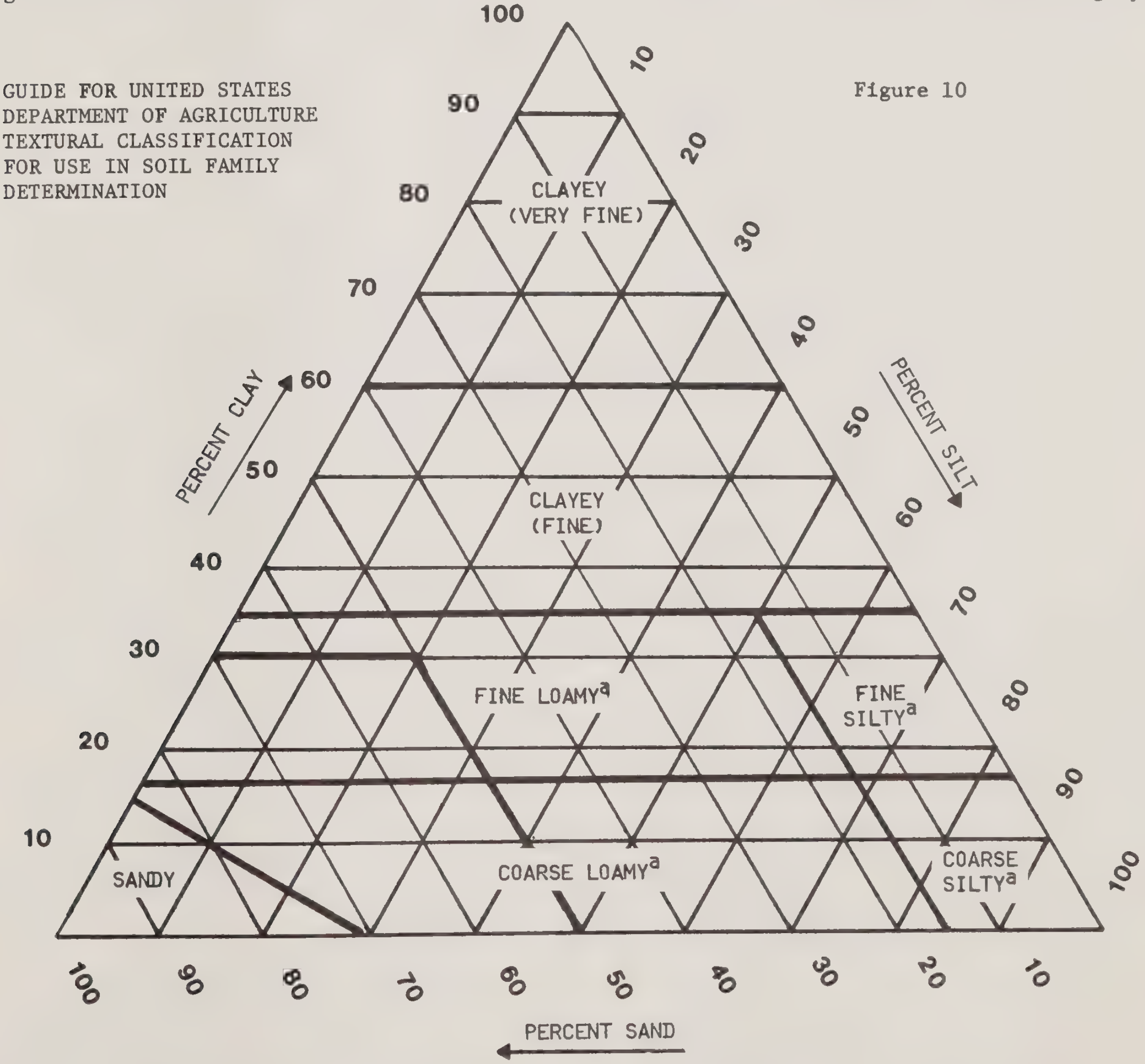
Soil texture refers to particle sizes composing the soil. Particles are classified as various grades of *gravel, sand, silt,* and *clay,* in decreasing order of size.

The U. S. Department of Agriculture has set up standard definitions of soil-texture classes in which the proportions of sand, silt and clay are given in percentages. The textural classifications are illustrated in the triangular diagram (Figure 10), which enables the percentages of all three components to be shown simultaneously. The word *loam* refers to a mixture in which no one of the three grades dominates over the other two.

Because of its important influence on many soil properties, texture is considered an important criterion for series differentiation, is a part of the soil type name, and is a part of each soil horizon description. Most soils are mixtures of all the particle sizes, and it is the percentage of each particle size in the mixture that determines the textural class. Where there are enough coarse fragments, such as gravel or stones in the soil to affect appreciably the water-holding capacity of other qualities related to use, the soil is termed "gravelly" or "stony". Figure 9 on page 18 indicates the standard partical size definitions as compared among the USDA, Unified and AASHO rating systems.

GUIDE FOR UNITED STATES DEPARTMENT OF AGRICULTURE TEXTURAL CLASSIFICATION FOR USE IN SOIL FAMILY DETERMINATION

Figure 10



Seven textural classes are used by the U. S. Soil Conservation Service in defining soil families. The various textural classes are determined by the relative amounts of sand, clay, and silt found in the soil series to be grouped into families. The above triangular graph accounts for all possible combinations of sand, clay, and silt and groups these combinations into the seven textural classifications.

Very fine sand (0.05-0.1) is treated as silt for family groupings; coarse fragments are considered the equivalent of coarse sand in the boundary between the silt and loamy classes.

Source: USDA Soil Conservation Service

Table 2
ALLOWABLE SOIL PRESSURE
(extracted from Uniform Building Code*)

Class of Material	Minimum Depth Footing Below Adjacent Virgin Ground	Value Permissible if Footing is at Minimum Depth lb./sq.ft.	Increase in Value for Each Foot of Depth that Footing is Below Minimum Depth lb./sq.ft.	Maximum Value lb./sq.ft.
1	2	3	4	5
Rock	0'	20% of ultimate crushing strength	0	20% of ultimate crushing strength
Compact coarse sand	1'	1500[1]	300[1]	8000
Compact fine sand	1'	1000[1]	200[1]	8000
Loose sand	2'	500[1]	100[1]	3000
Hard clay or sandy clay	1'	4000	800	8000
Medium-stiff clay or sandy clay	1'	2000	200	6000
Soft sandy clay or clay	2'	1000	50	2000
Adobe	1'6"	1000[2]	50	
Compact inorganic sand and silt mixtures	1'	1000	200	4000
Loose inorganic sand silt mixtures	2'	500	100	1000
Loose organic sand and silt mixtures and muck or bay mud	0'	0	0	0

[1]These values are for footings one foot (1') in width and may be increased in direct proportion to the width of the footing to a maximum of three times the designated value.
[2]For depths greater than eight (8') use values given for clay of comparable consistency.

*Uniform Building Code 1967 Ed., Vol. I, Sec. 2804, Table 28B

C-2 STRUCTURE

Soil structure refers to the way in which soil grains are grouped together to form aggregates held together by soil colloids. The way in which the soil is structured influences the rate at which water is absorbed by the soil, the susceptibility of the soil to erosion, and the ease of soil cultivation.

Structure mainly affects soil permeability, in that the relative permeability of granular, subangular blocky, blocky and platy structures is lower in each subsequent listing. Prismatic structure generally occurs as a compound structure that parts to angular or subangular blocks. Relative permeability is about the same as the blocky structure. Erodibility of soils is indirectly affected by soil structure because structure affects permeability, which in turn, to some extent controls runoff. In general, the greater the aggregation, the lower its erodibility. Soils with granular or subangular blocky structures are generally less erodible than other soils because they can transmit greater amounts of water when saturated without moving themselves.

The primary types of aggregations are defined as follows:

1. Platy: particles arranged around a plane, generally horizontal;

2. Prismatic: particles arranged around a vertical axis and bounded by relatively flat, vertical surfaces;

3. Blocklike: particles arranged around a point and bounded by flat or rounded surfaces;

4. Granular: particles arranged around a point and bounded by curved surfaces that are not accommodated to the adjoining aggregates and;

5. Columnar: particles arranged around a vertical axis with rounded tops and surfaces.

Some types of soils have no structure. These structureless soils are single grained or massive and adhere together without any regular cleavage.

C-3 CONSISTENCE

Soil consistency describes the evident characteristics of the soil at various moisture contents when influenced by the physical forces of cohesion and adhesion. In general, it is the feel of the soil and the ease with which a lump can be crushed by the fingers. If we would consider soil structure as basically a function of size, shape, and distinctness of peds, soil consistence would represent the sum strength of the forces that hold aggregates together. Soil consistence is expressed in terms that indicate degree of cohesion and adhesion, or degree of adhesion or resistance to deformation or rupture.

Terms commonly used to describe consistency are:

Loose - Noncoherent; will not hold together in a mass.

Friable - When moist, crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed into a lump.

Firm - When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic - When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between the thumb and forefinger.

Sticky - When wet, adheres to other material; tends to stretch somewhat and pull apart, rather than pull free from other material.

Hard - When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft - When dry, breaks into powder or individual grains under very slight pressure.

C-4 BEARING STRENGTH

The bearing strength is a rating of those properties of a soil pertaining to its susceptibility to decrease in volume when subject to load. In making evaluations for bearing strength, soil scientists consider such characteristics as allowable soil pressure, consistence, structure, permeability, depth to seasonal water table, shrink-swell potential and shear strength. Normally the first one-foot of the soil is not considered in the ratings.

The table on the preceding page indicates the allowable soil pressure for building foundations based on soil texture prescribed in the Uniform Building Code.

For the purpose of showing the limitations in allowable soil pressure, the allowable loads can be divided into 3 groupings as follows:

Allowable Soil Pressure (lbs./sq.ft.)	Degree of Limitation
1. More than 2000	Slight
2. 1000 - 2000	Moderate
3. Less than 1000	Severe

It should be noted that allowable soil pressure is only one factor in rating the bearing strength of a soil. The other characteristics mentioned above are used to modify the limitation ratings prescribed for allowable soil pressure. The map on the following page indicates the interpretive analysis of the various soil associations in the County for allowable soil pressure.

C-5 REACTION

Soil reaction is important in soil classification and interpretations mainly because of other soil qualities that can be inferred from it. It is an indication of the degree of acidity or alkalinity of soils and is expressed in terms of pH -- the logarithm of the reciprocal of the hydrogen ion concentration. (Thus a pH of 6 means a concentration of hydrogen ions of 10^{-6} or .000001.) With this notation pH7 is neutral; lower values indicate acidity; and higher values show alkalinity. Descriptive terms that correspond to ranges in pH values are shown in the following Table:

Soil Reaction Classification

Reaction Classification	pH Value Range
Extremely acid	<4.6
Very strongly acid	4.6-5.0
Strongly acid	5.1-5.5
Medium acid	5.6-6.0
Slightly acid	6.1-6.5
Neutral	6.6-7.3
Mildly alkaline	7.4-7.8
Moderately alkaline	7.9-8.4
Strongly alkaline	8.5-9.0
Very strongly alkaline	>9.0

Source: U. S. Soil Conservation Service, U.S.D.A.

Indirectly, soil reaction is an indication of the degree of weathering, the composition of the parent material, the amount of leaching that has occurred and the kind of vegetation that grew on the soil during early stages of formation.

In general, soils having a pH value of less than 4.5 are a rare occurrence whereas soils with a rating of 4.5-6.0 are common in humid climates. Ratings of 6.0-7.0 are common in subhumid and arid climates while those soils having pH values greater than 9.0 are usually limited to desert areas.

Values of pH can be used to determine crop suitability. A given species of plant usually has a specific range of soil reaction in which it grows best. They can also be used to indicate the need for lime from which plants extract calcium, one of the elements essential to plant growth. In general, low pH values indicate that plants will respond favorably to applications of lime on a particular soil.

C-6 SHRINK-SWELL

Shrink-swell behavior is that quality of the soil which determines its volume change with changes in moisture content.

Shrink-swell is an important but little appreciated process of continuing physical weathering of soils. This process particularly occurs in soils of fine silt and clay which absorb or give up soil water in alternate periods of rain and drought. Shrinkage forms soil cracks in dry periods, making the infiltration of rainfall much more rapid in early stages of an ensuing rain.

This volume-change behavior of soils is greatly influenced by the amount of moisture change and the amount and kind of clay in the soil. Limitation ratings are based upon these characteristics and a measure of the relative volume expansion between the soil's semiliquid and solid states.

Classification for shrink-swell behavior is normally based on the B horizon of the soil. Three degrees of limitation are recognized: low, moderate and high.

The criteria used in evaluating shrink-swell behavior are described as follows: (The interpretations are for lightweight structures three stories or less in height.)

Degree of Limitation:

Low - Soils having a clay percentage or percentage of predominately clay minerals of less than 19% (or less than 36% for Kaolinitic clay); a coefficient of Linear Extensibility* (COLE) of less than .03; a shrinkage index** of less than 5.0.

Moderate - Soils having between 18-35% mixed or montmorillontic clays (or more than 35% Kaolinitic clay); a COLE of .03 - .06; a shrinkage index of 5.0-7.0.

Severe - Soils having more than 35% mixed or montmorillontic clays; a COLE greater than .06; a shrinkage index greater than 7.0.

A map illustrating shrink-swell conditions identified in the County can be found on page 54A.

C-7 DEPTH TO BEDROCK OR IMPERVIOUS LAYER

As utilized in soils surveys, the soil depth to bedrock or an impervious layer (such as hardpans) is expressed in terms of effective depth. Effective depth is the depth to which a soil is readily penetrated by roots and utilized for extraction of water and plant nutrients. Effective depth is classified in the following ranges: **(see Figure 2)**:

Depth Class	Inches
Very deep	More than 60
Deep	36 to 60
Moderately deep	20 to 36
Shallow	10 to 20
Very shallow	Less than 10

Source: U. S. Soil Conservation Service, U. S. D. A.

The depth to bedrock or the impervious layer is an important consideration in determining soil drainage characteristics. USDA soils surveys do not consider the characteristics of material below a depth of five feet.

*Inches per inch.

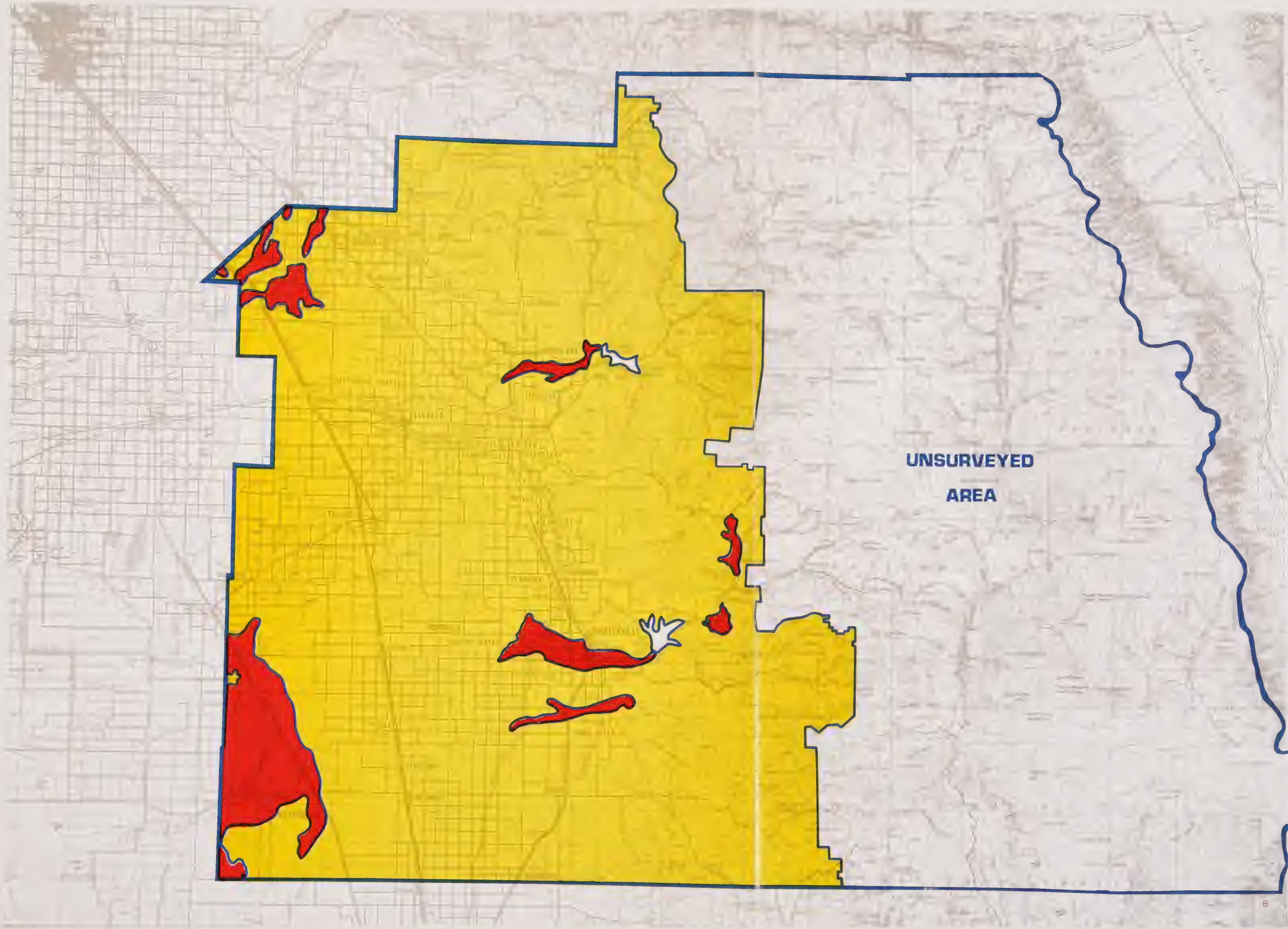
**The Shrinkage Index is the numerical difference between the Plastic Limit and the Shrinkage Limit. Special tests, as required by local ordinance, may be used in place of the Shrinkage Index.

ALLOWABLE SOIL PRESSURE

This map indicates the degree of limitation for allowable unit soil pressure based upon soil textures prescribed in Table 28-D of the Uniform Building Code (1967). In addition to allowable soil pressure, the basic properties affecting bearing strength and settlement of the natural soil are density, wetness, flooding, plasticity, texture, and shrink-swell potential.

The map shows that very few areas in the County have severe allowable soil pressure problems. These appear to be limited to areas characterized by young or recent deposits of alluvium such as the valley floodplains and the old Tulare Lake bed. Knowledge of allowable soil pressure characteristics is important in urban and regional planning since the emphasis in rating soils for dwellings is on the properties that affect foundations. The map gives ratings for undisturbed soils on which single family dwellings or other structures with similar foundation requirements can be built. Buildings of more than three stories and other buildings requiring a foundation mode in excess of that of a three story dwelling are not considered.

The map also shows that no area in the County is rated as having "slight" allowable pressure limitations. This is due to the fact that the behaviorial analysis is based upon generalized soil conditions. More intensive and detailed soil surveys would provide a basis for locating areas where no soil pressure problems would be expected.



ALLOWABLE SOIL PRESSURE

TULARE COUNTY

LEGEND

Limitations

Moderate – 1,000-2,000 lbs. per square inch

Severe – less than 1,000 lbs. per square inch

Note: *Soil limitation analysis are based upon the most representative behavior characteristics of the soil association. This in part explains why no association is shown as having slight limitations for allowable soil pressure.*

These areas simply cannot be mapped at this scale or level of complexity.

Source: <u>Report and General Soil Map Tulare County</u>, Soil Conservation Service, USDA

Soils underlain by rock at a depth of less than 20 inches are classified and named differently than soils underlain by bedrock at a depth of more than 20 inches. Similarly, soils with hardpan layers are always classified separate from those without hardpan layers. Depth to bedrock affects soil interpretations for uses such as farming, road construction, urban development, recreation, and engineering uses.

C-8 INHERENT FERTILITY

The inherent fertility of the soil is the relative capacity of the soil to supply nutrients to growing plants, without additions of fertilizers or soil amendments. At least sixteen elements are considered necessary for the growth of green plants. These consist of: carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), sulfur (S), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), molybdenum (Mo), boron (B) and chlorine (Cl).

We commonly refer to these elements as the plant nutrients and as essential elements. An element is said to be essential if the plant cannot complete its life cycle without it and if the malady that develops in its absence is curable only by that element.

The presence or absence of these nutrients can be established by laboratory analysis. The soils are thereafter rated according to the limitation or need to artificially apply these needed nutrients in order to assure productive plant growth.

C-9 LIQUID LIMIT AND PLASTICITY INDEX

Liquid limit and plasticity index are two interrelated terms which pertain to the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to the plastic state, and the liquid limit from the plastic to the liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Some soils such as those that are very sandy do not exhibit plasticity and thus do not have a plasticity index.

The determination of the liquid limit and plasticity characteristics of soils is quite significant in urban development. Roadways, for example, should not be located on soils exhibiting high plasticity. Similarly, soils having plasticity characteristics are considered to have severe limitations for foundation support.

The onset of plasticity in soils can be accelerated by ground shaking and is, therefore, related to earthquake activity. It is possible that even low intensity seismic vibrations which persist for several seconds may generate the onset of unexpected plasticity.

C-10 WIND EROSION

There are two types of wind erosional processes. The process in which soil material is picked up or lifted into the air by the force of wind is termed *deflation*. The second process where wind drives sand and dust particles against exposed rock or soil surfaces is known as *abrasion*. Abrasion requires the existence of materials carried by the wind whereas, deflation is accomplished by air currents alone.

The effects produced by abrasion are mainly confined to dry desert areas where bedrock surfaces, pebbles and boulders are abraded by wind-driven sand and silt. This "sand-blasting" phenomena is of little concern in soil management in Tulare County and, thus, is not considered further in this report.

Deflation, however, is always of concern in relatively arid areas such as Central California. Any cultivated land area where strong winds are common -- and especially an area of low rainfall -- has a potential for wind erosion by deflation (even some areas under irrigation). Usually, deflation is active only in the absence of vegetation and only in material that is capable of being lifted by wind. The wind velocity at which flowing air begins to move sand grains has been clocked at 5m/sec. (about 11 mph). The same wind velocity can maintain coarse silt suspended in the air. As wind velocities of this magnitude are a common occurrence in the Central Valley, the potential for extensive wind erosion is significant.

Studies of the "Dust Bowl" in the 1930's have shown that long-continued cultivation of even the best soils under low-rainfall conditions is a hazardous practice. As the soil becomes more and more pulverized with each year of cultivation, it becomes increasingly vulnerable to attack by wind. "Clean-farming" practices, removing all vegetation except the economic crop, helps to create conditions encouraging extensive wind erosion.

The climatic phenomena associated with wind erosion is a dense cloud of fine dust called a dust storm. It has been estimated that as much as 4,000 tons of dust may be suspended in a cubic mile of air in such a condition. Then, wind erosion by deflation represents a significant natural erosive force that must be considered in all actions undertaken to alter the physical environment.

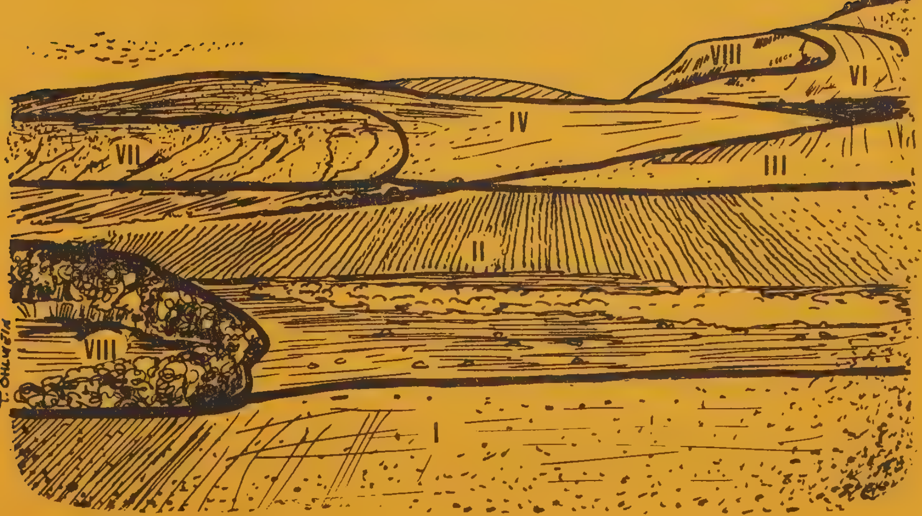
Deflation is limited by the amount of water in the soil which holds the soil together, encourages vegetation and thus inhibits wind erosion. A large amount of agricultural land is under irrigation during the dry summer months in Tulare County, and therefore serious deflation has not been a problem where soils are kept moist.

Good conservation practices to prevent deflation include the planting of windbreaks set in strips at right angles to the prevailing wind at intervals of a mile or so. It also involves planting or allowing strips of grass to grow, alternating with strips of cultivated crops. These windbreak and vegetation strip practices were common in the Central Valley when much of the area was dry farmed. Remnants of old windbreaks are still found occasionally along East-West roadways. However, with the intensive agricultural development brought about by expanded irrigation, the need for such conservation practice has diminished. In addition, windbreaks and vegetation strips are accused of using up scarce water and harboring insect pests. Today much of the usable land in the County has been planted to semi-permanent crops such as fruit and nut trees, and vineyards. Fortunately, these types of crops by themselves create a "dead air" layer above the surface of the soil which obviates deflation.

Thus, the effects of deflation are of little concern in the more intensively cultivated lands under irrigation. However, where dry farming still persists, or where overgrazing has occurred in non-irrigable rangeland, deflation can still occur. Lands which are undergoing conversion to urban uses are also susceptible due to termination of irrigation or due to construction practices.

Chapter V

General Description of Soils



CHAPTER V

GENERAL DESCRIPTION OF SOILS

There are 39 different soil associations on the accompanying General Soil Map of Tulare County which appears on the following page. These are named for the major soil series that occur within each unit. A soil series is a group of soil types that have about the same kind of profile or sequence of layers. Except for a difference in surface texture, all members of a soil series have major horizons or layers that are similar in thickness, arrangement and other important characteristics. Some soil associations on the General Soil Map have the same soil series for which they are named, but differ by properties or qualities of major importance to use and management. These are separated (or phased) by indicating differences such as slope, surface texture, or depth of soil.

The 39 soil associations for Tulare County are organized into 6 major groups based on soil characteristics and qualities, including slope. The six major groups and the soil associations within each group are described in detail in the following sections. These soil association descriptions have been extracted from the Report and General Soil Map of Tulare County, prepared and published by the Soil Conservation Service, Visalia office, October, 1967.

The soil series names cited herein are tentative and may be changed when the soils of the Tulare County area are correlated into the National Soil Classification System. However, changes in names will not affect the usefulness of the map and report because the soil properties and qualities do not change and the names are only a means of identifying the map unit.

GROUP 1 - AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, NEARLY LEVEL, POORLY TO MODERATELY WELL DRAINED, SALINE-ALKALI SOILS.

Eh El Peco Association

This association consists of somewhat poorly drained, moderately coarse textured soils developed in alluvium weathered from acid igneous rocks. Permeability is moderate to moderately rapid above the hardpan, runoff is slow to very slow and the erosion hazard is none to slight. The soils are nearly level on old alluvial fans. Vegetation consists of grasses, herbs and valley oak. Elevations range from 260 to 285 feet. Mean annual rainfall is 8 or 9 inches, mean annual air temperature is 64° F., and frost-free season is about 260 days. This association comprises about 1.3 percent of the County surveyed.

El Peco soils make up about 80 percent of the association. Foster, Hanford, Hesperia and Traver soils comprise about 20 percent.

El Peco soils have a very pale brown fine sandy loam, massive and strongly alkaline surface layer. The subsoil is very pale brown fine sandy loam, massive and strongly alkaline. The substratum is a light gray lime-silica hardpan.

These soils are used for cropland and pasture. The inherent fertility is low and the available water-holding capacity is 4 or 5 inches. The effective root depth is 18 to 36 inches.

The shrink-swell behavior is low. The limitations for septic tank filter fields are severe, and high for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment and embankment areas.

Fv-Eh - Fresno-El Peco Association

This association consists of somewhat poorly drained, moderately coarse and moderately fine textured soils developed in alluvium weathered from acid igneous rocks. Permeability is moderately slow to moderately rapid, runoff is slow to very slow and the erosion hazard is none to slight. The soils are nearly level on old alluvial fans and basins along the Kings and Tule Rivers. Vegetation consists of grasses, herbs and valley oak. Elevations range from 210 to 310 feet. Mean annual rainfall is 8 to 12 inches, mean annual air temperature is 63° to 64° F., and the frost-free season is about 250 to 260 days. This association comprises about 2.2 percent of the County surveyed.

Fresno soils make up about 50 percent and El Peco soils about 40 percent of the association. Temple and Traver soils comprise about 10 percent.

Fresno soils have a light gray to light brownish gray fine sandy loam, massive and strongly alkaline surface layer. The subsoil is light brownish gray sandy clay loam, prismatic and blocky, and strongly alkaline. The substratum is a light gray lime-silica hardpan. El Peco soils have a very pale brown fine sandy loam, massive and strongly alkaline surface layer. The subsoil is very pale brown fine sandy loam, massive and strongly alkaline. The substratum is light gray lime-silica hardpan.

These soils are used for cropland and pasture. The inherent fertility is low and the available water-holding capacity is 4 to 6 inches. The effective root depth is 18 to 36 inches. The shrink-swell behavior is moderate to low. The limitations for septic tank filter fields are severe, and high for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment and embankment areas.

Gw-Fp - Grangeville-Foster Association

This association consists of somewhat poorly to very poorly drained, moderately coarse-textured soils developed in material weathered from stratified, coarse and moderately coarse-textured alluvium. Permeability is moderate, runoff is very slow to slow and the erosion hazard is none to slight. The soils are nearly level on alluvial fans and basins in the Kings River area. Vegetation consists of grasses, herbs, shrubs and scattered trees. Elevations range from 300 to 310 feet. Mean annual rainfall is 8 to 15 inches, mean annual air temperature is 63° F., and the frost-free season is about 260 to 270 days. This association comprises about 0.5 percent of the County surveyed.

Grangeville soils make up about 50 percent and Foster soils about 45 percent of the association. Hesperia, Traver and Tujunga soils comprise about 5 percent.

Grangeville soils have a grayish brown fine sandy loam, grandular and mildly alkaline surface layer. The subsoil is light brownish gray fine sandy loam, grandular, slightly mottled and mildly alkaline. The substratum is pale brown, stratified, fine sandy loam, loamy fine sand and loam. It is massive with few mottles and is strongly alkaline. Foster soils have a gray sandy loam, massive in place and mildly to moderately alkaline surface layer. The subsoil is light gray sandy loam, massive, few mottles and moderately alkaline. The substratum is light olive gray loamy sand, massive and moderately alkaline.

These soils are used for cropland and vineyards. The inherent fertility is low to moderate and the available water-holding capacity is 5 to 7 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is low. The limitations for septic tank filter fields are moderate to severe, and high for untreated steel pipe. The allowable soil pressure is moderate to severe. The limitations for sewage lagoons are moderate for the impoundment and embankment areas.

Ha-Wd - Hacienda-Waukena Association

This association consists of moderately well to poorly drained, moderately fine textured soils developed in material weathered from stratified, moderately coarse to moderately-fine textured alluvium. Permeability is slow to very slow, runoff is slow and the erosion hazard is none to slight. The soils are nearly level in basins along the edge of the old Tulare Lake bed. Vegetation consists of salt tolerant grasses and valley oak. Elevations range from 310 to 325 feet. Mean annual rainfall is 8 to 12 inches, mean annual air temperature is 60 to 63° F., and the frost-free season is about 260 days. This association comprises about 0.4 percent of the County surveyed.

Hacienda soils make up about 55 percent and Waukena soils about 40 percent of the association. Hilmar, Merced, Mocho and Rossi soils comprise about 5 percent.

Hacienda soils have a light gray sandy loam, massive, strongly alkaline surface layer. The subsoil is olive gray sandy clay loam, columnar and very strongly alkaline. The substratum is olive gray sandy clay loam or clay loam fossil bearing lake bed deposit.

Waukena soils have a light gray fine sandy loam, massive and mildly alkaline surface layer. The subsoil is light yellowish brown sandy clay loam, columnar and blocky, and very strongly alkaline. The substratum is light gray to light brownish gray, stratified, fine sandy loam and clay loam, and very strongly alkaline.

These soils are used for cropland. Inherent fertility is low and the available water-holding capacity is 10 to 11 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is moderate. The soils have severe limitations for septic tank filter fields, and high for untreated steel pipe. The limitations for allowable soil pressure are moderate. The limitations for sewage lagoons are slight for the impoundment area and embankment area.

Hq-MM - Hilmar-Mocho Association

This association consists of moderately well to poorly drained, coarse to medium textured soils developed in material weathered from stratified, coarse to medium-textured alluvium. Permeability is slow to moderately rapid, runoff is slow to very slow and the erosion hazard is none to slight. The soils are nearly level in basins along the edge of the old Tulare Lake bed. Vegetation consists of salt tolerant grasses and shrubs. Elevations range from 205 to 210 feet. Mean annual rainfall is 8 to 12 inches, mean annual air temperature is 62 to 65° F., and the frost-free season is about 260 days. This association comprises about 3.3 percent of the County surveyed.

Hilmar soils make up about 50 percent and Mocho soils about 30 percent of the association. Hacienda, Merced, Rossi and Traver soils comprise about 20 percent.

Hilmar soils have a pale brown loamy sand, single grain, and mildly alkaline surface layer. The subsoil is very pale brown loamy sand, single grain, few mottles and very strongly alkaline. The substratum is light olive gray stratified, silt loam and fine sandy loam and strongly alkaline. Mocho soils have a grayish brown loam, granular, and moderately alkaline surface layer. The subsoil is light brownish gray loam, subangular blocky and moderately alkaline. The substratum is light brownish gray, fine sandy loam, subangular blocky, and moderately alkaline.

GENERAL SOILS MAP

Tulare County is characterized by six basic soil groups as identified on the accompanying map. Care should be taken not to confuse these soil groups with the land capability classes identified in Chapter VI. The groupings are based upon major physical and chemical characteristics of the soil, including slope. They are aggregated from the 39 soil associations which have been identified in the County.

The valley portion of the County is characterized by four basic soil groups (Groups 1, 2, 3 and 4) while the foothills and mountainous areas of the County contain most of the Group 5 and 6 soils. All the valley soils are moderately deep to very deep and are situated on nearly level to moderately sloping land. The mountainous areas of the County are dominated by soils which have a wide range of depth and are situated on moderately sloping to very steep land.

The easterly portion of the County is characterized by soils which are poorly to moderately well drained and affected by salts and alkali (Group 1). These soils have very slow percolation rates and are thus considered to have severe limitations for septic tank absorption fields.

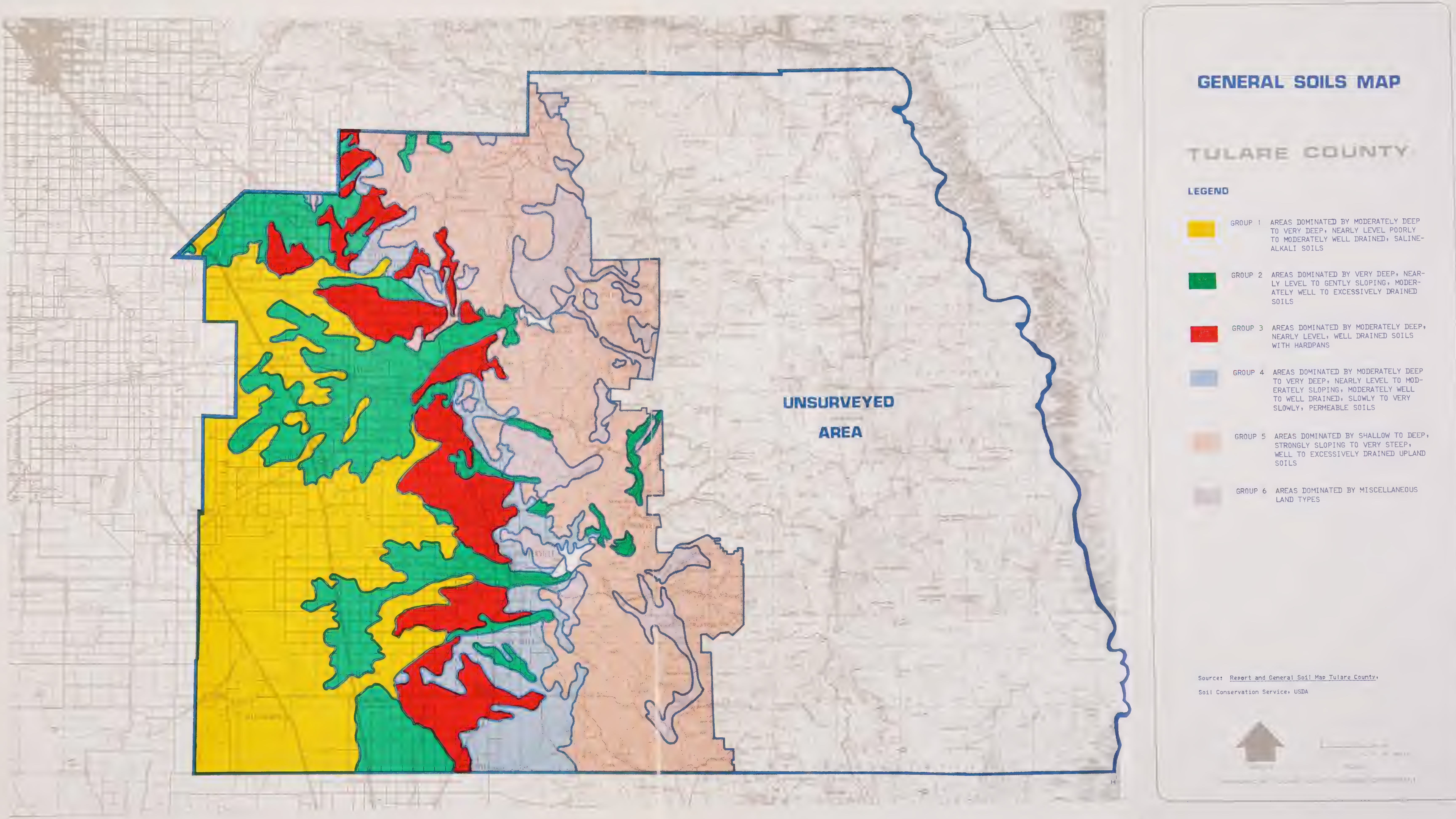
Group 2 soils consist of moderately well to excessively drained soils formed on more recent alluvial deposits of the major streams in the County. These soils are characteristically found in alluvial fans of the Kings, Kaweah and Tule Rivers, and have few limitations to urban growth and expansion. Less extensive areas of this soil group can also be found in the alluvial valleys of the Sierra Nevada Mountains.

Group 3 soils consist of well drained soils with hardpans or indurated layers situated in the profile. These soils are found in a nearly continuous band stretching along the base of the foothills. The permeability of the soil in these areas is limited by the hardpan layer and, thus, the soils are considered inappropriate for septic tank absorption fields.

The fourth soil group consists of soils which are moderately to well drained and slowly to very slowly permeable. These soils are also situated along the bases of the foothills but are less extensive than Group 3 soils. Group 4 soils typically contain high proportions of clay and fine textured material, and thus have a high shrink-swell behavior (soils which expand when saturated and contract when dry). Furthermore, because the soils have a very slow percolation rate, they are considered to be poor locations for septic tanks.

The fifth soil group contains most of the upland soil types which have been identified in the County. Because they are situated on sloping topography, they are considered to be well to excessivley drained, and in some cases retain severe erosional characteristics.

The last group (Group 6) covers areas dominated by miscellaneous land types. These include the rough broken land-rockland association and the riverwash association. Conditions in these areas are such that the soils have not reached a mature stage of development, and thus have little or no agricultural value and severe limitations for urban use.


GENERAL SOILS MAP
TULARE COUNTY
LEGEND
GROUP 1 AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, NEARLY LEVEL POORLY TO MODERATELY WELL DRAINED, SALINE-ALKALI SOILS
GROUP 2 AREAS DOMINATED BY VERY DEEP, NEARLY LEVEL TO GENTLY SLOPING, MODERATELY WELL TO EXCESSIVELY DRAINED SOILS
GROUP 3 AREAS DOMINATED BY MODERATELY DEEP, NEARLY LEVEL, WELL DRAINED SOILS WITH HARDPANS
GROUP 4 AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, NEARLY LEVEL TO MODERATELY SLOPING, MODERATELY WELL TO WELL DRAINED, SLOWLY TO VERY SLOWLY, PERMEABLE SOILS
GROUP 5 AREAS DOMINATED BY SHALLOW TO DEEP, STRONGLY SLOPING TO VERY STEEP, WELL TO EXCESSIVELY DRAINED UPLAND SOILS
GROUP 6 AREAS DOMINATED BY MISCELLANEOUS LAND TYPES
UNSURVEYED AREA
Source: Report and General Soil Map Tulare County, Soil Conservation Service, USDA

These soils are used for cropland and pasture. Inherent fertility is low and the available water-holding capacity is 7 to 10 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is low to moderate. The soils have severe limitations for septic tank filter fields, high limitations for untreated steel pipe and moderate to severe limitations for allowable soil pressure. The limitations for sewage lagoons are severe for the impoundment and moderate to severe for the embankment areas.

Ls - Lewis Association

This association consists of somewhat poorly drained, fine textured soils developed in alluvium weathered from metasedimentary rocks. Permeability is very slow, runoff is slow and the erosion hazard is none to slight. The soils are nearly level in basins and valley plains near Tulare Lake. Vegetation consists of salt tolerant grasses and shrubs. Elevations range from 260 to 350 feet. The mean annual rainfall is 9 to 12 inches, mean annual air temperature is 64° F., and the frost-free season is about 260 days. This association comprises about 1.7 percent of the County surveyed.

Lewis soils make up about 80 percent of the association. El Peco, Fresno and San Joaquin soils comprise about 20 percent.

Lewis soils have a pale brown clay loam, blocky and strongly alkaline surface layer. The subsoil is brown clay, blocky and strongly alkaline. The substratum is a brown weakly cementated lime-silica hardpan.

These soils are used for cropland and pasture. The inherent fertility is high and the available water-holding capacity is 4 to 11 inches. The effective root depth is 30 to 60 inches. The shrink-swell behavior is high. The limitations for septic tank filter fields are severe, and high for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are slight for the impoundment area and moderate for the embankment area.

MA-Ru - Merced-Rossi Association

This association consists of poorly drained, moderately fine and fine-textured soils developed in material weathered from old lake bed deposits and stratified sediments. The depth to intermittent water table is 2 to 4 feet. Permeability is slow, runoff is slow and the erosion hazard is none to slight. The soils are on nearly level basins along the edge of the old Tulare Lake bed. Vegetation consists of salt tolerant grasses and shrubs. Elevations range from 210 to 220 feet. Mean annual rainfall is 6 to 12 inches, mean annual air temperature is 64° F., and the frost-free season is about 260 days. This association comprises about 1.2 percent of the County surveyed.

Merced soils make up about 50 percent and Rossi soils about 35 percent of the association. Hilmar, Mocho and Traver soils comprise about 15 percent.

Merced soils have a very dark gray clay or clay loam, blocky, and strongly alkaline surface layer. The subsoil is olive brown sandy clay, blocky and moderately alkaline. The substratum is light yellowish brown sandy loam, massive and mildly alkaline. Rossi soils have a grayish brown loam, subangular blocky and moderately alkaline surface layer. The subsoil is light brownish gray clay loam, subangular, blocky, mottled, and strongly alkaline. The substratum is pale yellow stratified sediments, massive and strongly alkaline.

These soils are used for cropland and pasture. Inherent fertility is high and the available water-holding capacity is 10 or 11 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is high. The soils have severe limitations for septic tank filter fields, and high for untreated steel pipe. The limitations for allowable soil pressure are moderate. The limitations for sewage lagoons are slight for the impoundment and embankment areas.

Ti-TX - Temple-Traver Association

This association consists of somewhat poorly drained, moderately coarse to moderately fine textured soils developed in material weathered from stratified, moderately coarse to moderately fine textured alluvium. Permeability is moderately slow to slow, runoff is very slow to slow and the erosion hazard is none to slight. The soils are nearly level in basins along the old Tulare Lake shoreline. Vegetation consists of salt tolerant grasses and herbs, and a few scattered valley oak. Elevations range from 300 to 350 feet. Mean annual rainfall is 9 to 12 inches, mean annual air temperature is 64° or 65° F., and the frost-free season is about 260 days. This association comprises about 10.9 percent of the County surveyed.

Temple soils make up about 50 percent and Traver soils about 30 percent of the association. Foster and Fresno soils comprise about 20 percent.

Temple soils have a dark gray loam, massive and slightly acid surface layer. The subsoil is light olive gray clay loam, blocky, mottled and moderately alkaline. The substratum is pale olive stratified, fine sandy loam and sandy clay loam, massive and moderately alkaline. Traver soils have a light brownish gray fine sandy loam, massive and moderately alkaline surface layer. The subsoil is light brownish gray fine sandy loam, subangular blocky and strongly alkaline. The substratum is very pale brown, fine sandy loam, stratified, massive, few mottles and strongly alkaline.

These soils are used for cropland and pasture. The inherent fertility is moderate and the available water-holding capacity is 8 to 11 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is moderate to low. The limitations for septic tank filter fields are severe, and high for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are slight for the impoundment area and slight to moderate for the embankment area.

Tx-PH - Traver-Pond Association

This association consists of somewhat poorly drained, moderately coarse to moderately fine textured soils developed in material weathered from stratified, moderately coarse to moderately fine textured alluvium. Permeability is moderately slow to slow, runoff is slow to very slow and the erosion hazard is none to slight. The soils are nearly level on alluvial fans and basins along the old Tulare Lake shoreline. Vegetation consists of salt tolerant grasses and herbs. Elevations range from 325 to 340 feet. Mean annual rainfall is 9 to 12 inches, mean annual air temperature is 64° to 65° F., and the frost-free season is about 260 days. This association comprises about 4.5 percent of the County surveyed.

Traver soils make up about 50 percent and Pond soils about 45 percent of the association. Fresno, Hanford and Hesperia soils comprise about 5 percent.

Traver soils have a light grayish brown fine sandy loam, massive and moderately alkaline surface layer. The subsoil is light grayish brown fine sandy loam, subangular blocky and strongly alkaline. The substratum is very pale brown, fine sandy loam, stratified, massive, few mottles and strongly alkaline. Pond soils have a light brownish gray clay loam, blocky, and strongly alkaline surface layer. The subsoil is very pale brown sandy clay loam, massive and strongly alkaline. The substratum is very pale brown sandy loam, massive and moderately alkaline. Pond soils have an intermittent water table at a depth of 3 to 6 feet.

These soils are used for cropland and pasture. The inherent fertility is moderate and the available water-holding capacity is 8 to 11 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is low to high. The limitations for septic tank filter fields are severe, and high for uncoated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are slight for the impoundment area and moderate to slight for the embankment area.

GROUP 2 - AREAS DOMINATED BY VERY DEEP, NEARLY LEVEL TO GENTLY SLOPING MODERATELY WELL TO EXCESSIVELY DRAINED SOILS.

$\frac{\text{CG-LH}}{\text{AB}}$ - Chualar-Los Robles Association, 0 to 5 percent slopes

This association consists of well to moderately well drained, moderately fine-textured soils developed in material weathered from moderately coarse and moderately fine-textured alluvium. Permeability is moderate to moderately slow, runoff is slow and the erosion hazard is slight. The soils are nearly level to gently sloping on alluvial fans near the foothills on the east side of the County. Vegetation consists of grass, shrubs, and valley and interior live oak. Elevations range from 360 to 2000 feet. Mean annual rainfall is 12 to 25 inches, mean annual air temperature is 60° to 62° F., and the frost-free season is about 175 to 275 days. This association comprises about 1.2 percent of the County surveyed.

Chualar soils make up about 50 percent and Los Robles soils about 25 percent of the association. Porterville, San Joaquin and a moderately fine-textured soil comprise about 25 percent.

Chualar soils have a dark grayish brown sandy loam, grandular, and slightly acid surface layer. The subsoil is brown sandy clay loam, blocky, and neutral to mildly alkaline. The substratum is brown sandy loam, massive, and mildly alkaline. Los Robles soils have a brown clay loam, massive, and neutral surface layer. The subsoil is brown clay loam, massive, and neutral. The substratum is brown clay loam, massive, and neutral.

These soils are used for citrus and dry pasture. The inherent fertility is moderate and the available water-holding capacity is 10 to 12 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is moderate. The soils have severe limitations for septic tank filter fields, and moderate limitations for untreated steel pipe. They have moderate limitations for allowable soil pressure. The limitations for sewage lagoons are moderate for the impoundment and embankment areas.

Dg-Cf - Delhi-Calhi Association

This association consists of somewhat excessively to excessively drained, coarse-textured soils developed in material weathered from coarse-textured alluvium. Permeability is very rapid, runoff is very slow and the water erosion hazard is none to slight, but the wind erosion hazard is moderate. The soils are nearly level on alluvial fans along the Kings River. Vegetation consists of grass, shrubs, scattered valley oak and salt tolerant plants. Elevations range from 290 to 330 feet.

Mean annual rainfall is 8 to 12 inches, mean air temperature is 62° to 64° F., and the frost-free season is about 225 to 260 days. This association comprises about 0.2 percent of the County surveyed.

Delhi soils make up about 65 percent and Calhi soils about 25 percent of the association. Hanford, Hesperia and Tujunga soils comprise about 10 percent.

Delhi soils have a pale brown sand, single grain and slightly acid surface layer. The subsoil is pale brown sand, single grain and slightly acid. The substratum is light yellowish brown sand, single grain and slightly acid. Calhi soils have a pale brown loamy fine sand, single grain and moderately alkaline surface layer. The subsoil is pale brown loamy fine sand, single grain and strongly alkaline. The substratum is pale brown loamy fine sand, single grain and strongly alkaline.

These soils are used for cropland and vineyards. The inherent fertility is low and the available water-holding capacity is 2 to 5 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is low. The limitations for septic tank filter fields are slight, and low for untreated steel pipe. The limitation for allowable soil pressure is low. The limitations for sewage lagoons are severe for the impoundment and embankment areas.

Gx-Hd AB - Greenfield-Hanford Association, 0 to 5 percent slopes

This association consists of well to somewhat excessively drained, moderately coarse-textured soils developed in material weathered from stratified, coarse and moderately coarse-textured alluvium. Permeability is moderately rapid to rapid, runoff is very slow to medium and the erosion hazard is slight. The soils are on nearly level to gently sloping on alluvial fans, terraces and valley fill. Vegetation consists of grasses, shrubs and valley oak. Elevations range from 400 to 1300 feet. Mean annual rainfall is 10 to 20 inches, mean annual air temperautre is 62° to 64° F., and the frost-free season is about 165 to 260 days. This association comprises about 0.5 percent of the County surveyed.

Greenfield soils make up about 50 percent and Hanford soils about 30 percent of the association. Ahwahnee, Ducor, Exeter and Vista soils comprise about 20 percent.

Greenfield soils have a pale brown coarse sandy loam, massive and slightly acid surface layer. The subsoil is light yellowish brown fine sandy loam, subangular blocky and neutral. The substratum is brownish yellow, stratified, loamy sand, sandy loam and fine sandy loam, massive and neutral. Hanford soils have a pale brown fine sandy loam, grandular and slightly acid to neutral surface layer. The subsoil is pale brown fine sandy loam, massive and neutral. The substratum is pale brown or very pale brown, stratified, fine sandy loam and loamy sand, massive, and mildly alkaline.

These soils are used for cropland and vineyards. The inherent fertility is moderate and the available water-holding capacity is 8 to 12 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is low. The limitations for septic tank filter fields are slight, and low for untreated steel pipe. The allowable soil pressure is moderate to severe. The limitations for sewage lagoons are severe for the impoundment area and moderate for the embankment area.

Hd-Hl - Hanford-Hesperia Association.

This association consists of well to somewhat excessively drained, moderately coarse-textured soils developed in material weathered from stratified, coarse to medium textured alluvium. Permeability is moderately rapid, runoff is very slow to slow and the erosion hazard is none to slight. The soils are nearly level on alluvial fans and valley fill along the Kings River. Vegetation consists of grasses, shrubs and scattered valley oak. Elevations range from 300 to 400 feet. Mean annual rainfall is 8 to 15 inches, mean annual air temperature is 62° F., and the frost-free season is about 250 to 275 days. This association comprises about 1.1 percent of the County surveyed.

Hanford soils make up about 60 percent and Hesperia soils about 30 percent of the Association. Delhi, Foster and Tujunga soils comprise about 10 percent.

Hanford soils have a pale brown fine sandy loam, granular and slightly acid to neutral surface layer. The subsoil is pale brown fine sandy loam, massive and neutral. The substratum is pale brown or very pale brown, stratified, fine sandy loam and loamy sand, massive, and mildly alkaline. Hesperia soils have a brown sandy loam, massive and mildly alkaline surface layer. The subsoil is brown sandy loam, massive and moderately alkaline. The substratum is pale brown loam and sandy loam, massive and moderately alkaline.

These soils are used for cropland and vineyards. The inherent fertility is moderate and the available water-holding capacity is 8 to 10 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is low. The limitations for septic tank filter fields are slight and low for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate for the embankment area.

H1-Fp - Hesperia-Foster Association

This association consists of somewhat excessively to moderately well drained, moderately coarse-textured soils developed in material weathered from coarse, moderately coarse and medium textured alluvium. Permeability is moderately rapid to moderate, runoff is slow to very slow and the erosion hazard is none to slight. The soils are nearly level on alluvial fans, basins and valley fill along the Kaweah and Tule Rivers. Vegetation consists of grasses, shrubs and scattered valley oak. Elevations range from 300 to 375 feet. Mean annual rainfall is 8 to 15 inches, mean annual air temperature is 61° to 63° F., and the frost-free season is about 250 to 275 days. This association comprises about 8.8 percent of the County surveyed.

Hesperia soils make up about 50 percent and Foster soils about 45 percent of the association. Temple, Traver and Tujunga soils comprise about 5 percent.

Hesperia soils have a brown sandy loam, massive and mildly alkaline surface layer. The subsoil is brown sandy loam, massive and moderately alkaline. The substratum is pale brown loam and sandy loam, massive and moderately alkaline. Foster soils have a gray and light gray sandy loam, massive in place and mildly to moderately alkaline surface layer. The subsoil is light gray sandy loam, massive, few mottles and moderately alkaline. The substratum is light olive gray loamy sand, massive and moderately alkaline.

These soils are used for cropland, orchards and vineyards. The inherent fertility is moderate and the available water-holding capacity is 8 to 10 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is low. The limitations for septic tank filter fields are slight to moderate and low to high for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe to moderate for the impoundment area and moderate for the embankment area.

H1-Hd - Hesperia-Hanford Association

This association consists of somewhat excessively to well drained, moderately coarse textured soils developed in material weathered from stratified, coarse to medium textured alluvium. Permeability is moderately rapid, runoff is slow to very slow and the erosion hazard is none to slight. The soils are nearly level on alluvial fans and valley fill along the Kings River. Vegetation consists of grasses, shrubs and scattered valley oak. Elevations range from 350 to 420 feet. Mean annual rainfall is 8 to 15 inches, mean annual air temperature is 62° F., and the frost-free season is about 250 to 275 days. This association comprises about 6.6 percent of the County surveyed.

Hesperia soils make up about 60 percent and Hanford soils about 20 percent of the association. Greenfield, Pond and Traver soils comprise about 20 percent.

Hesperia soils have a brown sandy loam, massive and mildly alkaline surface layer. The subsoil is brown sandy loam, massive and moderately alkaline. The substratum is pale brown loam and sandy loam, massive and moderately alkaline.

Hanford soils have a pale brown fine sandy loam, granular and slightly acid to neutral surface layer. The subsoil is pale brown fine sandy loam, massive and neutral. The substratum is pale brown or very pale brown stratified fine sandy loam and loamy sand, massive and mildly alkaline.

These soils are used for cropland, orchards and vineyards. The inherent fertility is moderate and the available water-holding capacity is 8 to 10 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is low. The limitations for septic tank filter fields are slight, and low for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate for the embankment area.

TD-Gw - Tujunga-Grangeville Association

This association consists of somewhat excessively to moderately well drained, coarse and moderately coarse textured soils developed in material weathered from stratified, coarse to medium textured alluvium. Permeability is very rapid to moderate, runoff is slow to very slow and the erosion hazard is none to slight. The soils are nearly level on alluvial fans and basins along the Kings River. Vegetation consists of grasses, shrubs and scattered valley oak. Elevations range from 300 to 310 feet. Mean annual rainfall is 8 to 15 inches, mean annual air temperature is 64° F., and the frost-free season is about 250 to 275 days. This association comprises about 1.5 percent of the County surveyed.

Tujunga soils make up about 50 percent and Grangeville soils about 45 percent of the association. Delhi, Hanford and Hesperia soils comprise about 5 percent.

Tujunga soils have a pale brown sand, single grain and slightly acid to neutral surface layer. The subsoil is pale brown sand, single grain and slightly acid to neutral. The substratum is stratified, sand, coarse sand and gravel, single grain and neutral. Grangeville soils have a grayish brown fine sandy loam, granular and mildly alkaline surface layer. The subsoil is light brownish gray fine sandy loam, granular, slightly mottled and mildly alkaline.

The substratum is pale brown, stratified, fine sandy loam, loamy fine sand and loam. It is massive with few mottles and is strongly alkaline.

These soils are used for pasture and cropland. The inherent fertility is low and the available water-holding capacity is 2 to 7 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is low. The limitations for septic tank filter fields are slight to moderate and low to high for untreated steel pipe. The allowable soil pressure is severe. The limitations for sewage lagoons are moderate to severe for the impoundment area and severe to moderate for the embankment area.

Vs-Hl - Visalia-Hesperia Association, 0 to 5
AB percent slopes

This association consists of moderately well to somewhat excessively drained, moderately coarse textured soils developed in material weathered from moderately coarse and medium textured alluvium. Permeability is moderately rapid to rapid, runoff is slow to medium, and the erosion hazard is slight. The soils are nearly level to gently sloping on alluvial fans, basins and valley fill. Vegetation consists of grasses, shrubs and scattered oak. Elevations range from 350 to 500 feet. Mean annual rainfall is 9 to 12 inches, mean annual air temperature is 62° to 64° F., and the frost-free season is about 240 to 260 days. This association comprises about 0.9 percent of the County surveyed.

Visalia soils make up about 50 percent and Hesperia soils about 35 percent of the association. Foster, Hanford and San Joaquin soils comprise about 15 percent.

Visalia soils have a gray to dark gray fine sandy loam, massive and neutral surface layer. The subsoil is grayish brown fine sandy loam, massive and mildly alkaline. The substratum is brown stratified, sandy loam and fine sandy loam, massive and moderately alkaline.

Hesperia soils have a brown sandy loam, massive and mildly alkaline surface layer. The subsoil is brown sandy loam, massive and moderately alkaline. The substratum is pale brown loam and sandy loam, massive and moderately alkaline.

These soils are used for cropland, citrus and vineyards. The inherent fertility is moderate and the available water-holding capacity is 5 to 10 inches. The effective root depth is 5 feet or more. The shrink-swell behavior is low. The limitations for septic tank filter fields are slight to moderate and low for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate for the embankment area.

GROUP 3 - AREAS DOMINATED BY MODERATELY DEEP, NEARLY LEVEL WELL DRAINED SOILS WITH HARDPANS.

Si-Ex - San Joaquin-Exeter Association

This association consists of well drained, medium, moderately fine textured soils developed in alluvium weathered from acid igneous rocks. Permeability is very slow to moderate, runoff is slow and the erosion hazard is none to slight. The soils are nearly level on old alluvial fans, low terraces and basins. Vegetation consists of grasses, herbs and valley oak. Elevations range from 420 to 500 feet. Mean annual rainfall is 9 to 15 inches, mean annual temperature is 62° to 65° F., and the frost-free season is about 250 to 280 days. This association comprises about 9.9 percent of the County surveyed.

San Joaquin soils make up about 70 percent and Exeter soils about 20 percent of the association. Chualar, Ducor and Greenfield soils comprise about 10 percent.

San Joaquin soils have a yellowish red sandy loam, massive and medium acid surface layer. The subsoil is reddish yellow sandy clay, blocky and slightly acid. The substratum is a reddish yellow hardpan. Exeter soils have a light brownish gray and brown fine sandy loam, massive and slightly acid surface layer. The subsoil is brown loam, massive and slightly acid. The substratum is a reddish brown hardpan that is mildly alkaline.

These soils are used for cropland, orchards, pasture and vineyards. The inherent fertility is moderate and the available water-holding capacity is 2 to 4 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is moderate. The limitations for septic tank filter fields are severe, and moderate to high for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment and embankment area.

GROUP 4 - AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, NEARLY LEVEL TO MODERATELY SLOPING, MODERATELY WELL TO WELL DRAINED SLOWLY TO VERY SLOWLY PERMEABLE SOILS.

DY/SC - Ducor Association, 2 to 9 percent slopes

This association consists of moderately well to well drained, fine textured soils developed in alluvium weathered from acid igneous rocks. Permeability is slow to very slow, runoff is slow to medium and the erosion hazard is slight to moderate. The soils are gently to moderately sloping on alluvial fans and terraces in the Porterville area and south to the Kern County line. Vegetation consists of grasses and valley oak. Elevations range from 500 to 800 feet. Mean annual rainfall is 9 to 12 inches, mean annual air temperature is 63° to 64° F., and the frost-free season is about 250 to 270 days. This association comprises about 4.2 percent of the County surveyed.

Ducor soils make up about 80 percent of the association. Exeter, Hesperia and San Joaquin soils comprise about 20 percent.

Ducor soils have a brown clay, prismatic and moderately alkaline surface layer. The subsoil is brown clay, blocky or massive, mottled and moderately alkaline. The substratum is yellowish brown fine sandy loam, massive and moderately alkaline.

These soils are used for cropland and range. The inherent fertility is high and the available water-holding capacity is 10 to 12 inches.

The effective root depth is 5 feet or more. The shrink-swell behavior is high. The limitations for septic tank filter fields are severe, and high for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are moderate for the impoundment area and moderate for the embankment area.

PI-Cy/AC - Porterville-Centerville association, 0 to 9 percent slopes

This association consists of well drained, fine textured soils developed in alluvium weathered from basic igneous and metamorphic rocks. Permeability is slow to very slow, runoff is slow to medium and the erosion hazard is slight to moderate. The soils are nearly level to moderately sloping on alluvial fans and terraces. Vegetation consists of grasses, herbs and scattered oaks. Elevations range from 350 to 600 feet. Mean annual rainfall is 10 to 15 inches, mean annual air temperature is 62° to 64° F., and the frost-free season is about 220 to 260 days. This association comprises about 3.0 percent of the County surveyed.

Porterville soils make up about 60 percent and Centerville soils about 20 percent of the association. Cibo, Ducor, Exeter and San Joaquin soils comprise about 20 percent.

Porterville soils have a dark reddish brown clay, blocky and neutral surface layer. The subsoil is dark reddish gray and dark brown clay, blocky and mildly to moderately alkaline. The substratum is dark brown clay, massive and moderately alkaline. Centerville soils have a dark gray to dark reddish brown clay, blocky and slightly acid surface layer. The subsoil is dark reddish brown clay, blocky and mildly alkaline. The substratum is cobble and gravel size metamorphic and basic igneous rocks.

These soils are used for citrus and pasture. The inherent fertility is high and the available water-holding capacity is 7 to 11 inches. The effective root depth is 20 to 60 inches or more. The shrink-swell behavior is high. The limitations for septic tank filter fields are severe, and high for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are moderate for the impoundment area and moderate for the embankment area.

GROUP 5 - AREAS DOMINATED BY SHALLOW TO DEEP, STRONGLY SLOPING TO VERY STEEP, WELL TO EXCESSIVELY DRAINED UPLAND SOILS.

Ah-AJ EF-2 Ahwahnee-Auberry association, 15 to 50 percent slopes, eroded.

The association consists of well to somewhat excessively drained, moderately coarse and moderately fine textured soils developed in material weathered from acid igneous rocks. Rock outcrop range from 10 to 50 percent. Permeability is rapid to moderately slow, runoff is rapid and erosion hazard is high. The soils are on moderately steep to steep mountainous uplands. Vegetation consists of grasses, shrubs and trees. Elevations range from 800 to 3500 feet. Mean annual rainfall is 15 to 35 inches, mean annual air temperature is 55° to 60° F., and the frost free season is about 175 to 230 days. This association comprises about 1.2 percent of the county surveyed.

Ahwahnee soils make up about 50 percent and Auberry soils about 30 percent of the association. Sierra and Vista soils comprise about 20 percent.

Ahwahnee soils have a grayish brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is brown to pale brown coarse sandy loam, subangular blocky and slightly acid. The parent material is weathered acid igneous rock. Auberry soils have a grayish brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is brown light sandy clay loam, blocky and strongly acid. The parent material is strongly weathered acid igneous rock.

These soils are used for range. The inherent fertility is moderate and the available water-holding capacity is 3 to 6 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is low to moderate. The limitations for septic tank filter fields are severe, and low to moderate for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate to slight for the embankment area. The range site is deep granite soils.

Ah-SL DE-2 - Ahwahnee-Sierra Association, 9 to 30 percent slopes, eroded.

This association consists of well to somewhat excessivley drained, moderately coarse and moderately fine textured soils developed in material weathered from acid igneous rocks. Rock outcrops range from 10 to 25 percent. Permeability is rapid to moderately slow, runoff is medium to rapid and the erosion hazard is high. The soils are strongly sloping to moderately steep on mountainous uplands. Vegetation consists of grasses, shrubs and oak. Elevations range from 500 to 3500 feet. Mean annual rainfall is 15 to 35 inches, mean annual air temperature is 59° to 60° F., and the frost-free season is about 175 to 230 days. This association comprises about 0.4 percent of the County surveyed.

Ahwahnee soils make up about 60 percent and Sierra soils about 20 percent of the association. Auberry, Coarsegold and Vista soils comprise about 20 percent.

Ahwahnee soils have a grayish brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is brown to pale brown coarse sandy loam, subangular blocky and slightly acid. The parent material is weathered acid igneous rock. Sierra soils have a brown coarse sandy loam, massive and medium acid surface layer. The subsoil is red clay loam, massive and slightly acid. The parent material is strongly weathered acid igneous rock.

These soils are used for range and pasture. The inherent fertility is moderate and the available water-holding capacity is 3 to 6 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is low to moderate. The limitations for septic tank filter fields are severe, and low to moderate for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate to slight for the embankment area. The range site is deep granitic soils.

Ah-Vt FG - Ahwahnee-Vista Association, 30 to 75 percent slopes

This association consists of well to somewhat excessively drained, moderately coarse textured soils developed in material weathered from acid igneous rocks. Permeability is moderately rapid to rapid, runoff is rapid, and the erosion hazard is high. The soils are steep to very steep on mountainous uplands. Vegetation consists of grasses, herbs, shrubs and trees. Elevations range from 600 to 5000 feet. Mean annual rainfall is 10 to 30 inches, mean annual air temperature is 60° to 64° F., and the frost-free season is about 175 to 260 days. This association comprises about 1.8 percent of the County surveyed.

Ahwahnee soils make up about 50 percent and Vista soils about 40 percent of the association. Auberry and Sierra soils comprise about 10 percent.

Ahwahnee soils have a grayish brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is brown to pale brown coarse sandy loam, subangular blocky and slightly acid. Rock outcrop ranges from 10 to 50 percent. The parent material is weathered acid igneous rock. Vista soils have a dark grayish brown to dark brown coarse sandy loam, granular and neutral surface layer. The subsoil is brown to yellowish brown coarse sandy loam, massive and slightly acid. The parent material is weathered acid igneous rock.

These soils are used for range. The inherent fertility is moderate and the available water-holding capacity is 3 to 6 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is low. The limitations for septic tank filter fields are severe, and low for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate for the embankment area. The range site is deep granitic soils.

$\frac{\text{AJ-Vt}}{\text{E}}$ - <u>Auberry-Vista Association, 15 to 30 percent slopes</u>.

This association consists of well to somewhat excessively drained, moderately coarse and moderately fine textured soils developed in material weathered from acid igneous rocks. Rock outcrop ranges from 10 to 25 percent. Permeability is moderately slow to moderately rapid, runoff is medium to rapid and the erosion hazard is moderate. The soils are moderately steep on mountainous uplands. Vegetation consists of grasses, herbs, shrubs and oak trees. Elevations range from 3,000 to 3,500 feet. Mean annual rainfall is 10 to 35 inches, mean annual air temperature is 55° to 64° F., and the frost-free season is about 150 to 250 days. This association comprises 0.1 percent of the County surveyed.

Auberry soils make up about 50 percent and Vista soils about 30 percent of the association. Ahwahnee and Sierra soils comprise about 20 percent.

Auberry soils have a grayish brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is brown light sandy clay loam, blocky and strongly acid. The parent material is strongly weathered acid igneous rock. Vista soils have a dark grayish brown to dark brown coarse sandy loam, granular and neutral surface layer. The subsoil is brown to yellowish brown coarse sandy loam, massive and slightly acid. The parent material is weathered acid igneous rock.

These soils are used for range. The inherent fertility is moderate and the water holding capacity is 3 to 6 inches.

The effective root depth is 20 to 36 inches. The shrink-swell behavior is moderate to low. The limitations for septic tank filter fields are severe and moderate to low for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and slight to moderate for the embankment area. The range site is deep granitic soils.

$\frac{\text{CJ-Tv}}{\text{EF}}$ - <u>Cibo-Trabuco Association, 15 to 50 percent slopes</u>.

This association consists of well to somewhat excessively drained, fine textured soils developed in material weathered from basic igneous rocks. Permeability is moderately slow to slow, runoff is medium to rapid and erosion hazard is moderate to high. The soils are moderately steep to steep on mountainous uplands. Vegetation consists of grasses, shrubs and trees. Elevations range from 500 to 4,000 feet. Mean annual rainfall is 10 to 25 inches, mean annual air temperature is 60° to 62° F., and the frost-free season is about 150 to 260 days. This association comprises about 2.5 percent of the County surveyed.

Cibo soils make up about 65 percent and Trabuco soils about 15 percent of the association. Centerville, Las Posas and Porterville soils comprise about 20 percent.

Cibo soils have a dark brown stony clay, subangular blocky and slightly acid surface layer. The subsoil is brown very stony clay, blocky and mildly alkaline. The parent material is fractured and weathered basic igneous rock. Trabuco soils have a brown loam, granular and slightly acid surface layer. The subsoil is reddish brown clay, blocky and neutral. The parent material is slightly weathered basic igneous rock.

These soils are used for range. The inherent fertility is moderate and the available water-holding capacity is 3 to 7 inches. The effective root depth is 10 to 36 inches. The shrink-swell behavior is high. The limitations for septic tank filter fields are severe and high for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate for the embankment area. The range site is Rocky Loam Foothills.

$\frac{\text{CQ-Fw}}{\text{FG}}$ - <u>Coarsegold-Friant Association, 30 to 75 percent slopes</u>.

This association consists of well to somewhat excessively drained, moderately coarse and moderately fine textured soils developed in material weathered from metasedimentary rocks. Permeability is moderately rapid, runoff is rapid and the erosion hazard is

high. The soils are steep to very steep on mountainous uplands. Vegetation consists of grasses, herbs, shrubs and trees. Elevations range from 1,500 to 4,500 feet. Mean annual rainfall is 15 to 30 inches, mean annual air temperature is 58° to 62° F., and the frost-free season is about 150 to 200 days. This association comprises about 2.4 percent of the County surveyed.

Coarsegold soils make up about 55 percent and Friant soils about 35 percent of the association. Ahwahnee, Auberry, Sierra and Vista soils comprise about 10 percent.

Coarsegold soils have a brown loam, massive and slightly acid surface layer. The subsoil is reddish brown gravelly clay loam, blocky and neutral to slightly acid. The parent material is weathered metasedimentary rock. Friant soils have a brown fine sandy loam, granular and slightly acid surface layer. The subsoil is brown fine sandy loam, massive and neutral. The parent material is slightly weathered quartz mica schist.

These soils are used for range. Small acreages are used for dryland pasture. The inherent fertility is moderate and the available water-holding capacity is 1 to 6 inches. The effective root depth is 10 to 36 inches. The shrink-swell behavior is moderate to low. The limitations for septic tank filter fields are severe and low to moderate for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and slight to severe for the embankment area. The range site is Rocky Loam Foothills.

Hs-SC - Holland-Shaver Association, 30 to 75
FG-2 percent slopes, eroded.

This association consists of well to somewhat excessively drained, moderately coarse and moderately fine textured soils developed in material weathered from acid igneous rocks. Rock outcrop range from 10 to 50 percent. Permeability is moderately slow to rapid, runoff is rapid and the erosion hazard is high. The soils are steep to very steep on mountainous uplands. Vegetation consists of cedar, oak and pine with an understory of grasses and shrubs. Elevations range from 4,500 to 7,000 feet. Mean annual rainfall is 30 to 40 inches, mean annual air temperature is 45° to 57° F., and the frost-free season is about 75 to 200 days. This association comprises about 0.7 percent of the County surveyed.

Holland soils make up about 50 percent and Shaver soils about 45 percent of the association. Musick and Stump Springs soils comprise about 5 percent.

Holland soils have a dark grayish brown and dark brown loam, granular and medium to slightly acid surface layer. The subsoil is brown and reddish brown sandy clay loam or clay loam, subangular blocky and slightly to medium acid. The parent material is strongly weathered acid igneous rock. Shaver soils have a dark grayish brown coarse sandy loam, crumb structure and slightly acid surface layer. The subsoil is pale brown coarse sandy loam, massive and medium acid. The parent material is strongly weathered acid igneous rock.

The soils are used for timber production. The inherent fertility is moderate and the available water-holding capacity is 2 to 6 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is moderate to low. The limitations for septic tank filter fields are severe and moderate to low for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and slight to moderate for the embankment area. The woodland suitability group is 6.

Hs-sm - Holland-Stump Springs Association, 50
G to 75 percent slopes.

This association consists of well to somewhat excessively drained, moderately fine textured soils developed in material from acid igneous rocks. Rock outcrop range from 10 to 50 percent. Permeability is moderately slow to slow, runoff is rapid and the erosion hazard is high. The soils are very steep on mountainous uplands in the Tule River Indian Reservation. Vegetation consists of cedar, oak and pine with an understory of grasses and shrubs. Elevations range from 5,000 to 7,000 feet. Mean annual rainfall is 30 to 40 inches, mean annual air temperature is 45° to 57° F., and the frost-free season is about 75 to 150 days. This association comprises about 0.5 percent of the County surveyed.

Holland soils make up about 50 percent and Stump Springs soils about 40 percent of the association. Musick and Shaver soils comprise about 10 percent.

Holland soils have a dark grayish brown and dark brown loam, granular and medium to slightly acid surface layer. The subsoil is brown and reddish brown sandy clay loam or clay loam, subangular blocky and slightly to medium acid. The parent material is strongly weathered acid igneous rock. Stump Springs soils have a grayish brown and very pale brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is light yellowish brown heavy sandy clay loam, blocky and strongly acid. The parent material is strongly weathered acid igneous rock.

These soils are used for timber production. The inherent fertility is moderate and the available water-holding capacity is 2 to 6 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is moderate. The limitations for septic tank filter fields are severe and moderate for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and slight for the embankment area. The Woodland suitability group is 6.

$\frac{\text{Li}}{\text{F}}$ - Las Posas Association, 30 to 50 percent slopes.

This association consists of well drained, fine textured soils developed in material weathered from basic igneous rocks. Permeability is slow to moderately slow, runoff is rapid and the erosion hazard is high. The soils are steep on mountainous uplands. Vegetation consists of grasses, herbs and shrubs. Elevations range from 800 to 1,200 feet. Mean annual rainfall is 10 to 15 inches, mean annual air temperature is 62° to 64° F., and the frost-free season is about 220 days. This association comprises about 0.4 percent of the County surveyed.

Las Posas soils make up about 85 percent of the association. Coarsegold and Trabuco soils comprise about 15 percent.

Las Posas soils have a reddish brown loam, granular and slightly acid surface layer. The subsoil is dark red clay, blocky and neutral. The parent material is weathered basic igneous rock.

This soil is used for range. The inherent fertility is moderate and the available water-holding capacity is 6 to 8 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is high. The limitations for septic tank filter fields are severe and high for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate for the embankment area. The range site is Rocky Loam Foothills.

$\frac{\text{me-CA}}{\text{FG-2}}$ - Musick-Chawanakee Association, 30 to 75 percent slopes, eroded.

This association consists of well to excessivley drained, moderately coarse and moderately fine textured soils developed in material weathered from acid igneous rocks. Rock outcrop range from 10 to 50 percent. Permeability is moderately slow to moderately rapid, runoff is rapid and the erosion hazard is high. The soils are steep to very steep on mountainous uplands. Vegetation consists of pine, cedar and oak with grasses, herbs and shrubs in open areas. Elevations range from 4,000 to 5,000 feet. Mean annual rainfall is 30 to 40 inches, mean annual air temperature is 48° to 56° F., and the frost-free season is 75 to 130 days. This association comprises about 0.4 percent of the County surveyed.

Musick soils make up about 50 percent and Chawanakee soils about 25 percent of the association. Shaver and Stump Springs soils comprise about 25 percent.

Musick soils have a grayish brown loam, granular and slightly acid surface layer. The subsoil is red heavy clay loam, prismatic and medium acid. Chawanakee soils have a grayish brown coarse sandy loam, granular, medium acid surface layer. The subsoil is very pale brown coarse sandy loam, granular or massive, medium acid. The parent material is strongly weathered acid igneous rock.

These soils are used for timber production. The inherent fertility is moderate and the water-holding capacity is 3 to 6 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is moderate to low. The limitations for septic tank filter fields are severe and moderate to low for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and slight to moderate for the embankment area. The woodland suitability groups are 6 and 7.

$\frac{\text{SC-sm}}{\text{G}}$ - Shaver-Stump Springs Association, 50 to 75 percent slopes.

This association consists of well to somewhat excessively drained, moderately coarse and moderately fine textured soils developed in material weathered from acid igneous rocks. Rock outcrop range from 10 to 50 percent. Permeability is rapid to slow, runoff is rapid and the erosion hazard is high. The soils are very steep on mountaineous uplands. Vegetation consists of pine, cedar, oak and shrubs. Elevations range from 5,000 to 7,000 feet. Mean annual rainfall is 35 to 40 inches, mean annual air temperature is 45° to 50° F., and the frost-free season is 75 to 130 days. This association comprises about 0.3 percent of the County surveyed.

Shaver soils make up about 50 percent and Stump Springs soils about 45 percent of the association. Holland soils comprise about 5 percent.

Shaver soils have a dark grayish brown and grayish brown coarse sandy loam, crumb structure and slightly acid surface layer. The subsoil is pale brown coarse sandy loam, massive and medium acid. The parent material is strongly weathered acid igneous rock. Stump Springs soils have a grayish brown and very pale brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is light yellowish brown heavy sandy clay loam, blocky and strongly acid. The parent material is strongly weathered acid igneous rock.

These soils are used for timber production. The inherent fertility is moderate and the available water-holding capacity is 2 to 5 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is low to moderate. The limitations for septic tank filter fields are severe, and low to moderate for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate to slight for the embankment area. The woodland suitability group is 6.

<u>SH-AJ</u> - <u>Sheridan-Auberry Association, 15 to 30</u>
E <u>percent slopes</u>.

This association consists of well to somewhat excessively drained, medium and moderately fine textured soils developed in material weathered from acid igneous rocks. Permeability is moderately slow to moderately rapid, runoff is medium and the erosion hazard is moderate. The soils are moderately steep on mountainous uplands. Vegetation consists of grasses, shrubs and oak. Elevations range from 3,000 to 4,000 feet.

Mean annual rainfall is 18 to 30 inches, mean annual air temperature is 55° to 60° F., and the frost-free season is about 170 to 260 days. This association comprises about 0.1 percent of the County surveyed.

Sheridan soils make up about 60 percent and Auberry soils about 25 percent of the association. Coarsegold and Friant soils comprise about 15 percent.

Sheridan soils have a dark grayish brown loam, granular and slightly acid surface layer. The subsoil is dark grayish brown loam, subangular blocky and slightly acid. The parent material is strongly weathered acid igneous rock. Auberry soils have a grayish brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is brown light sandy clay loam, blocky and strongly acid. Rock outcrop range from 10 to 50 percent. The parent material is strongly weathered acid igneous rock.

These soils are used for range. The inherent fertility is moderate and the available water-holding capacity is 3 to 6 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is low to moderate. The limitations for septic tank filter fields are severe, and moderate to low for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate to slight for the embankment area. The range site is Deep Granitic Soils.

<u>SH-AJ</u> - <u>Sheridan-Auberry Association, 30 to</u>
F-2 <u>50 percent slopes, eroded</u>.

This association consists of well to somewhat excessively drained, medium and moderately fine textured soils developed in material weathered from acid igneous rocks. Permeability is moderately slow to moderately rapid, runoff is rapid and the erosion hazard is high. The soils are steep on mountainous uplands. Vegetation consists of grasses, shrubs and oak. Elevations range from 3,800 to 4,000 feet. Mean annual rainfall is 18 to 30 inches, mean annual air temperature is 55° to 60° F., and the frost-free season is about 170 to 260 days. This association comprises about 4.1 percent of the County surveyed.

Sheridan soils make up about 65 percent and Auberry soils about 25 percent of this association. Coarsegold and Vista soils comprise about 10 percent.

Sheridan soils have a dark grayish brown loam, granular and slightly acid surface layer. The subsoil is dark grayish brown loam, subangular blocky and slightly acid. The parent material is strongly weathered acid igneous rock. Auberry soils have a grayish brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is light brown sandy clay loam, blocky and strongly acid. Rock outcrop range from 10 to 50 percent. The parent material is strongly weathered acid igneous rock.

These soils are used for range. The inherent fertility is moderate and the available water-holding capacity is 3 to 6 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is low to moderate. The limitations for septic tank filter fields are severe, and low to moderate for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate to slight for the embankment area. The range site is Deep Granitic Soils.

<u>SL-Ah</u> - <u>Sierra- Ahwahnee Association, 15 to</u>
EF <u>50 percent slopes</u>.

This association consists of well to somewhat excessively drained, moderately coarse and moderately fine textured soils developed in material weathered from acid igneous rock. Rock outcrop range from 10 to 50 percent. Permeability is moderately slow to rapid, runoff is medium to rapid and the erosion hazard is moderate to high. The soils are moderately steep to steep on mountainous uplands. Vegetation consists of grasses, shrubs and oak. Elevations range from 1,500 to 3,500 feet. Mean annual rainfall is 15 to 35 inches, mean annual air temperature is 59° to 60° F., and the frost-free season is about 175 to 230 days. This association comprises about 4.7 percent of the County surveyed.

Sierra soils make up about 50 percent and Ahwahnee soils about 45 percent of the association. Auberry soils comprise about 5 percent.

Sierra soils have a brown coarse sandy loam, massive and medium acid surface layer. The subsoil is red clay loam, massive and slightly acid. The parent material is strongly weathered acid igneous rock. Ahwahnee soils have a grayish brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is brown to pale brown coarse sandy loam, subangular blocky and slightly acid. The parent material is weathered acid igneous rock.

These soils are used for range. The inherent fertility is moderate and the available water-holding capacity is 3 to 6 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is moderate to low. The limitations for septic tank filter fields are severe, moderate to low for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and slight to moderate for the embankment area. The range site is Deep Granitic Soils.

$\frac{\text{SL-AJ}}{\text{EG}}$ - Sierra-Auberry Association, 15 to 75 percent slopes.

This association consists of well to somewhat excessively drained, moderately fine textured soils developed in material weathered from acid igneous rocks. Rock outcrop range from 10 to 50 percent. Permeability is moderate to moderately slow, runoff is medium to rapid and the erosion hazard is moderate to high. The soils are moderately steep to very steep on mountainous slopes. Vegetation consists of grasses, herbs, shrubs and oak. Elevations range from 1,000 to 5,000 feet. Mean annual rainfall is 18 to 35 inches, mean annual air temperature is 55° to 60° F., and the frost-free season is about 180 to 230 days. This association comprises about 6.5 percent of the County surveyed.

Sierra soils make up about 50 percent and Auberry soils about 45 percent of the association. Ahwahnee, Trabuco and Vista soils comprise about 5 percent.

Sierra soils have a brown coarse sandy loam, massive and medium acid surface layer. The subsoil is red clay loam, massive and slightly acid. The parent material is strongly weathered acid igneous rock. Auberry soils have a grayish brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is brown light sandy clay loam, blocky and strongly weathered acid igneous rock.

These soils are used for range. The inherent fertility is moderate and the available water-holding capacity is 3 to 6 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is moderate. The limitations for septic tank filter fields are severe, and moderate for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and slight for the embankment area. The range site is Deep Granitic Soils.

$\frac{\text{SQ}}{\text{FG}}$ - Sites Association, 30 to 75 percent slopes

This association consists of well drained, fine textured soils developed in material weathered from metamorphic rocks. Permeability is moderately slow to slow, runoff is rapid and the erosion hazard is high. The soils are steep to very steep as mountainous uplands in the northeast corner of the Tule River Indian Reservation. Vegetation consists of pine, redwood and hardwood trees with an understory of grasses and shrubs. Elevations range from 5,500 to 6,300 feet. Mean annual rainfall is 30 to 45 inches, mean annual air temperature is 50° to 56° F., and the frost-free season is about 80 to 125 days. This association comprises about 0.3 percent of the County surveyed.

Sites soils make up about 85 percent of the association. Coarsegold soils comprise about 15 percent.

Site soils have a brown loam, granular and slightly acid surface layer. The subsoil is red clay, angular and sub-angular blocky and strongly acid. The parent material is weathered metamorphic rock.

The soil is used for timber production. The inherent fertility is high and the available water-holding capacity is 6 to 9 inches. The effective root depth is 36 to 60 inches. The shrink-swell behavior is moderate. The limitations for septic tank filter fields are severe, and high for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate for the embankment area. The woodland suitability group is 6.

Vt-AJ - Vista-Auberry Association, 30 to 75
FG percent slopes.

This association consists of well to somewhat excessively drained, moderately coarse and moderately fine textured soils developed in material weathered from acid igneous rock. Rock outcrop range from 10 to 50 percent. Permeability is moderately rapid to moderately slow, runoff is rapid and the erosion hazard is high. The soils are steep to very steep on mountainous uplands in the Sand Creek and Eshom Valley areas. Vegetation consists of grasses, herbs, shrubs and oak trees. Elevations range from 1,000 to 3,500 feet. Mean annual rainfall is 10 to 36 inches, mean annual air temperature is 55° to 64° F., and the frost-free season is about 150 to 250 days. This association comprises about 2.6 percent of the County surveyed.

Vista soils make up about 70 percent and Auberry soils about 25 percent of the association. Ahwahnee and Sierra soils comprise about 5 percent.

Vista soils have a dark grayish brown to dark brown coarse sandy loam, granular and neutral surface layer. The subsoil is a brown to yellowish brown coarse sandy loam, massive and slightly acid. The parent material is weathered acid igneous rock. Auberry soils have a grayish brown coarse sandy loam, granular and slightly acid surface layer. The subsoil is brown light sandy clay loam, blocky and strongly weathered acid igneous rock.

These soils are used for range. The inherent fertility is moderate and the available water-holding capacity is 3 to 6 inches. The effective root depth is 20 to 36 inches. The shrink-swell behavior is low to moderate. The limitations for septic tank filter fields are severe, and low to moderate for untreated steel pipe. The allowable soil pressure is moderate. The limitations for sewage lagoons are severe for the impoundment area and moderate to slight for the embankment area. The range site is Deep Granitic Soils.

GROUP 6 - AREAS DOMINATED BY MISCELLANEOUS LAND TYPES

RB-RL - Rough broken land - Rock land Association

This association consists of very steep and extremely steep mountainous areas and very steep side slopes along intermittent drainage channels. The land is in the foothills and on intermediate mountain slopes of the Sierra Nevada Mountains, runoff is very rapid and the erosion hazard is high. Vegetation consists of grasses, scattered shrubs and trees. Tree growth is usually sparse and scrubby. Elevations range from 600 to 7,000 feet. Mean annual rainfall is about 10 to 50 inches and mean annual temperature is about 45° to 60° F. This association comprises about 6.9 percent of the County surveyed.

Rough broken land makes up about 70 percent and Rock land about 20 percent of the association. Deeper, less rocky soils comprise about 10 percent.

Rough broken land ordinarily is not stony and is deeply dissected by narrow V-shaped valleys. The local relief is generally between 25 to 500 feet. Soil slipping is often common and geologic erosion is active. Rock land has very shallow soils and 25 percent or more rock outcrops.

This association is dominately used for water supply, recreation and wildlife. Some areas are used for grazing and timber production. This association has severe limitations for urban development.

RW - Riverwash Association

This association consists of excessively drained stream bed deposits subject to periodic overflow. They are usually on nearly level or gently sloping river or creek beds along the Kaweah, St. Johns, Tule Rivers and Lewis Creek. There is little or no vegetation. This association comprises about 0.2 percent of the County surveyed.

Riverwash make up about 85 percent of the association. Stony coarse textured soils comprise about 15 percent.

This association has little or no agricultural value. They are a source of sand and gravel for commercial use. Riverwash has severe limitations for urban development.

A classic example of soil erosion in a valueable orchard. Such damage is extremely expensive to correct. The development of more lands in steeper slope areas in the county may create an increase in such danger due to modifying vegetative cover and organizing drainage in higher slope areas.

Soil Conservation Service

Here on this roadside cut-bank water introduced to the exposed material has caused a slump. Long rains, melting snow or poor grading practices can generate this hazard.

Tulare County Road Department

Chapter VI

Soil Interpretations

CHAPTER VI

SOIL INTERPRETATIONS

The General Soils Map shows the spatial distribution of dominant soils in Tulare County. Several interpretations were made of these soil map units in the 1967 General Soils Report prepared by the Soil Conservation Service. For the purposes of broad framework planning these soil suitability studies* were designed to permit a preliminary assessment of:

1. The engineering properties of soils as an aid in the development and selection of desirable spatial distribution patterns for residential, commercial, industrial, agricultural, and recreational land use development;

2. The soil-plant relationships for agricultural and nonagricultural uses, including natural wildlife relationships, as an aid in the selection of desirable spatial distribution patterns for permanent agricultural and recreational greenbelts and open spaces;

3. The suitability and limitations of soils for engineering applications, such as private on-site sewage disposal facilities, agricultural and urban drainage systems, foundations for buildings and structures, and water storage reservoirs and embankments as an aid in the planning and preliminary design of specific development proposals and in the application of such plan implementation devices as zoning, subdivision control, and official mapping;

4. The engineering properties of soils as an aid in the selection of highway, railway, airport, pipeline, and other transportation facility location; and

5. The location of potential sources of sand, gravel, and other mineral resources.

Soil interpretations for these purposes are based on soil characteristics and qualities, and predictions for the major soils within the soil association as to their behavior when put to specific uses. All interpretations are based on a soil depth of five feet or less than five feet where bedrock is encountered at a lesser depth.

*Soils surveys and Land Use Planning, pages 43-44

In soil analyses prepared by the U. S. Soil Conservation Service, the soils are generally rated on the basis of soil limitations or hazards. The ratings used are very slight, slight or low, moderate, severe or high, and very severe. The definition of each rating classification is as follows:

1. Very Slight: A condition in which the soil is relatively or completely free of limitation, thus conditions are highly favorable for the intended use.*

2. Slight or Low: Soils are relatively free of limitations that affect the intended use or the limitations are easy to overcome. This condition requires only the normal investigations and precautions during planning and construction. Development costs should be somewhat less than average for the area.

3. Moderate: Soils have moderate limitations which can be overcome with correct planning, careful design and good management. This condition usually requires investigations and precautions in addition to those normally required. Development costs tend to be above average, and the additional costs compensate for or correct the existing limitations.

4. Severe or High: Soils have severe limitations which require careful planning and above average design and management. This often requires major soil reclamation work. These limitations, when encountered, require a close look as development costs are often uneconomical, and the development of an alternate site might prove more economical. In any event, competent professional aid should be sought during both the planning and construction phases of development.

5. Very Severe: Denotes extreme limitations or highly unfavorable conditions requiring extreme measures to overcome. Because of the extensive added costs, the use for the stated purpose is generally uneconomical and unpractical.

*NOTE: This classification is rarely used in soil interpretations prepared by S.C.S.

The soil associations for Tulare County were interpreted for eleven different purposes in the 1967 report. These are shown on Table 3 "Index of Soil Mapping Units and Interpretive - Groupings". All mapped areas of the ratings are general and not suited for specific planning. Other important interpretations can be made by predicting the behavior of these soils for other purposes.

Table No. 4 indicates various characteristics and qualities of each soil association described in the 1967 report. The Table includes a generalized description of a representative profile for each association and an assessment rating for such characteristics as natural drainage, erosion hazard, subsoil permeability and available water-holding capacity.

The sections following these two Tables provide a somewhat detailed definition of the criteria used in soil suitability analysis. These criteria provide a basis for integrating soil studies into environmental resource management and County growth and development policies.

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TABLE 3

INDEX of SOIL MAPPING UNITS and INTERPRETIVE GROUPINGS

F.G. Stephens

Name L.W. Waterman Date Oct 1967

WORK UNIT or SURVEY AREA TULARE COUNTY GENERAL SOIL MAP Page 1 of 4

MAP SYMBOL	SOIL NAME	Percent 1/ of Association	INTERPRETIVE GROUPING AND SOIL LIMITATION RATINGS: Capability Unit		Vegetative Group	Hydrologic Group	Shrink-swell Behavior	Septic Tank Filter Fields	Untreated Steel Pipe	Allowable Soil Pressure	Sewage Lagoons		Range Site	Woodland Suitability Group
			Irrigated	Dry							Impoundment	Embankment		
GROUP 1 - AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, NEARLY LEVEL, POORLY TO MODERATELY WELL DRAINED SALINE-ALKALI SOILS														
Eh	El Peco association													
	El Peco	80	IIIs6		F	C	low	severe	high	moderate	severe	severe 4/	2/	3/
		(20)												
Fw-Eh	Fresno-El Peco association													
	Fresno	50	IIIs6		F	C	moderate 7/	severe	high	moderate	severe	severe 4/	2/	3/
	El Peco	40	IIIs6		F	C	low	severe	high	moderate	severe	severe	2/	3/
		(10)												
Gw-Fp	Grangeville-Foster association													
	Grangeville	50	IIs6		F	B	low	moderate	high	severe 7/	moderate	moderate	2/	3/
	Foster	45	IIs6		F	B	low	severe 7/	high	moderate	moderate	moderate	2/	3/
		(5)												
Ha-Wd	Hacienda-Waukena association													
	Hacienda	55	IVs6		F	C	moderate	severe	high	moderate	slight	slight	2/	3/
	Waukena	40	IVs6		F	D 7/	moderate	severe	high	moderate	slight	slight	2/	3/
		(5)												
Hq-MM	Hilmar-Mocho association													
	Hilmer	50	IIs6		F	B	low	severe	high	severe 7/	severe	severe 7/	2/	3/
	Mocho	30	IIs6		F	B	moderate 7/	severe	high	moderate	severe	moderate	2/	3/
		(20)												
Ls	Lewis association													
	Lewis	80	IVs6		F	D	high	severe	high	moderate	slight	moderate	2/	3/
		(20)												
MA-Ru	Merced-Rossi association													
	Merced	50	IVs6		F	D	high	severe	high	moderate	slight	slight	2/	3/
	Rossi	35	IVs6		F	D	high	severe	high	moderate	slight	slight	2/	3/
		(15)												
Ti-Tx	Temple-Traver association													
	Temple	50	IIs6		F	C	moderate 7/	severe	high	moderate	slight	slight 7/	2/	3/
	Traver	30	IIs6		F	B	low	severe	high	moderate	slight	moderate	2/	3/
		(20)												
Tx-PH	Traver-Pond association													
	Traver	50	IIs6 7/		F	B	low	severe	high	moderate	slight	moderate 7/	2/	3/
	Pond	45	IIIs6		F	C 7/	high 7/	severe	high	moderate	slight	slight	2/	3/
		(5)												
GROUP 2 - AREAS DOMINATED BY VERY DEEP, NEARLY LEVEL TO GENTLY SLOPING, MODERATELY WELL DRAINED SALINE-ALKALI SOILS														
CG-LR / AB	Chualar-Los Robles association, 0 to 5 percent slopes													
	Chualar	50	IIe1		A	C	moderate	severe	moderate	moderate	moderate	slight	2/	3/
	Los Robles	25	IIe1		A	C	moderate	severe	moderate	moderate	moderate	slight	2/	3/
		(25)												
Dg-Cf	Delhi-Calhi association, 0 to 2 percent slopes													
	Delhi	65	IIIs4		B	A	low	slight	low	severe	severe	severe	2/	3/
	Calhi	25	IIIs4		B	A	low	slight	low	severe	severe	severe	2/	3/
		(10)												

1/ Percent in (-) gives percent of other soils in the associations. (See descriptions)

2/ Not used for range

3/ Not used for woodland

4/ Severe limitation due to hardpan

7/ Indicates rating to be used when coloring single-purpose Interpretive Maps

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TABLE 3

INDEX of SOIL MAPPING UNITS and INTERPRETIVE GROUPINGS

WORK UNIT or SURVEY AREA TULARE COUNTY GENERAL SOIL MAP

F.G. Stephens
Name L.W. Waterman   Date Oct 1967
Page 2 of 4

MAP SYMBOL	SOIL NAME	Percent 1/ of Association	INTERPRETIVE GROUPING AND SOIL LIMITATION RATINGS: Capability Unit		Vegetative Group	Hydrologic Group	Shrink-swell Behavior	Septic Tank Filter Fields	Untreated Steel Pipe	Allowable Soil Pressure	Sewage Lagoons		Range Site	Woodland Suitability Group
			Irrigated	Dry							Impoundment	Embankment		
Gx-Rd / AB	Greenfield-Hanford association, 0 to 5 percent slopes													
	Greenfield	50	IIe1		A	B	low	slight	low	severe7/	severe	moderate	2/	3/
	Hanford	30	IIe1		A	B	low	slight	low	moderate	severe	moderate	2/	3/
		(20)												
Hd-Hl	Hanford-Hesperia association													
	Hanford	60	I		A	B	low	slight	low	moderate	severe	moderate	2/	3/
	Hesperia	30	I		A	B	low	slight	low	moderate	severe	moderate	2/	3/
		(10)												
Hl-Fp	Hesperia-Foster association													
	Hesperia	50	I		A	B	low	slight	low	moderate	severe7/	moderate	2/	3/
	Foster	45	I		A	B	low	moderate7/	high7/	moderate	moderate	moderate	2/	3/
		(5)												
Hl-Hd	Hesperia-Hanford association													
	Hesperia	60	I		A	B	low	slight	low	moderate	severe	moderate	2/	3/
	Hanford	20	I		A	B	low	slight	low	moderate	severe	moderate	2/	3/
		(20)												
Tu-Gw	Tujunga-Grangeville association													
	Tujunga	50	IIIs4		B7/	A	low	slight	low	severe	severe7/	severe7/	2/	3/
	Grangeville	45	IIIs4		A	B7/	low	moderate7/	high7/	severe	moderate	moderate	2/	3/
		(5)												
Vs-Hl / AB	Visalia-Hesperia association, 0 to 5 percent slopes													
	Visalia	50	IIe1		A	B	low	moderate7/	low	moderate	severe	moderate	2/	3/
	Hesperia	35	IIe1		A	B	low	slight	low	moderate	severe	moderate	2/	3/
		(15)												
GROUP 3- AREAS DOMINATED BY MODERATELY DEEP, NEARLY LEVEL, WELL DRAINED SOILS WITH HARDPANS														
Sl-Ex	San Joaquin-Exeter association, 0 to 2 percent slopes													
	San Joaquin	70	IIIs8		G	C	moderate	severe	high7/	moderate	severe	severe4/	2/	3/
	Exeter	20	IIIs8		G	C	moderate	severe	moderate	moderate	severe	severe4/	2/	3/
		(10)												
GROUP 4- AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, NEARLY LEVEL TO MODERATELY SLOPING, MODERATELY WELL TO WELL DRAINED SLOWLY TO VERY SLOWLY PERMEABLE SOILS														
Dy / BC	Ducor association, 2 to 9 percent slopes													
	Ducor	80	IIIe5		C	D	high	severe	high	moderate	moderate	moderate	RLF6/	3/
		(20)												
Pl-Cy / AC	Porterville-Centerville association, 0 to 9 percent slopes													
	Porterville	60	IIIe5		C	D	high	severe	high	moderate	moderate	moderate	2/	3/
	Centerville	20	IIIe5		C	D	high	severe	high	moderate	moderate	moderate	2/	3/
		(20)												
GROUP 5- AREAS DOMINATED BY SHALLOW TO DEEP, STRONGLY SLOPING TO VERY STEEP WELL TO EXCESSIVELY DRAINED UPLAND SOILS														
Ah-AJ / EF-2	Ahwahnee-Auberry association, 15 to 50 percent slopes, eroded													
	Ahwahnee	50	VIIs1		J	B7/	low7/	severe	low7/	moderate	severe	moderate7/	DGS5/	3/
	Auberry	30	VIIs1		J	C	moderate	severe	moderate	moderate	severe	slight	DGS5/	3/
		(20)												

1/ Percent in (-) gives percent of other soils in the association. (See descriptions)
2/ Not used for range
3/ Not used for woodland
4/ Severe limitation due to hardpan
5/ Deep Granitic Soils
6/ Rocky Loam Foothills
7/ Indicates rating to be used when coloring single-purpose Interpretive Maps

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TABLE 3

INDEX of SOIL MAPPING UNITS and INTERPRETIVE GROUPINGS

F. G. Stephens
Name L. W. Waterman   Date Oct 1967

WORK UNIT or SURVEY AREA TULARE COUNTY GENERAL SOIL MAP   Page 3 of 4

MAP SYMBOL	SOIL NAME	Percent 1/ of Association	INTERPRETIVE GROUPING AND SOIL LIMITATION RATINGS											
			Capability Unit		Vegetative Group	Hydrologic Group	Shrink Swell Behavior	Septic Tank Filter Fields	Untreated Steel Pipe	Allowable Soil Pressure	Sewage Lagoons		Range Site	Woodland Suitability Group
			Irrigated	Dry							Impoundment	Embankment		
Ah-SL / DE-2	Ahwahnee-Sierra association, 9 to 30 percent slopes, eroded													
	Ahwahnee	60		VIs1	G	B7/	low7/	severe	low7/	moderate	severe	moderate7/	DGS5/	3/
	Sierra	20		VIs1	G	C	moderate	severe	moderate	moderate	severe	slight	DGS5/	3/
		(20)												
Ah-Vt / FG	Ahwahnee-Vista association, 30 to 75 percent slopes													
	Ahwahnee	50		VIIs17/	J	B	low	severe	low	moderate	severe	moderate	DGS5/	3/
	Vista	40		VIIe1	J	B	low	severe	low	moderate	severe	moderate	DGS5/	3/
		(10)												
AJ-Vt / E	Auberry-Vista association, 15 to 30 percent slopes													
	Auberry	50		VIs1	G	C7/	moderate7/	severe	moderate7/	moderate	severe	slight7/	DGS5/	3/
	Vista	30		VIs1	G	B	low	severe	low	moderate	severe	moderate	DGS5/	3/
		(20)												
CJ-Tv / EF	Cibo-Trabuco association, 15 to 50 percent slopes													
	Cibo	65		VIe8	G	D7/	high	severe	high	moderate	severe	moderate	RLF6/	3/
	Trabuco	15		VIe8	G	C	high	severe	high	moderate	severe	moderate	RLF6/	3/
		(20)												
CJ-Fw / FG	Coarsegold-Friant association, 30 to 75 percent slopes													
	Coarsegold	55		VIIe8	J	C7/	moderate7/	severe	moderate7/	moderate	severe	slight	RLF6/	3/
	Friant	35		VIIe8	J	D	low	severe	low	moderate	severe	severe 7/	RLF6/	3/
		(10)												
Hs-SC / FG-2	Holland-Shaver association, 30 to 75 percent slopes, eroded													
	Holland	50		VIIs1	J	C7/	moderate7/	severe	moderate7/	moderate	severe	slight	2/	6
	Shaver	45		VIIs1	J	B	low	severe	low	moderate	severe	moderate7/	2/	6
		(5)												
Hs-sm / G	Holland-Stump Springs association, 50 to 75 percent slopes													
	Holland	50		VIIs1	J	C	moderate	severe	moderate	moderate	severe	slight	2/	6
	Stump Springs	40		VIIs1	J	C	moderate	severe	moderate	moderate	severe	slight	2/	6
		(10)												
Li / F	Las Posas association, 30 to 50 percent slopes													
	Las Posas	85		VIe8	G	C	high	severe	high	moderate	severe	moderate	RLF	3/
		(15)												
Me-CA / FG-2	Musick-Chawanakee association, 30 to 75 percent slopes, eroded													
	Musick	50		VIIs1	J	C7/	moderate7/	severe	moderate7/	moderate	severe	slight7/	2/	6
	Chawanakee	25		VIIs1	J	B	low	severe	low	moderate	severe	moderate	2/	7
		(25)												
SC-sm / G	Shaver-Stump Springs association, 50 to 75 percent slopes													
	Shaver	50		VIIs1	J	B	low	severe	low	moderate	severe	moderate7/	2/	6
	Stump Springs	45		VIIs1	J	C7/	moderate7/	severe	moderate7/	moderate	severe	slight	2/	6
		(5)												

1/ Percent in (-) gives percent of other soils in the associations. (See descriptions)
2/ Not used for range
3/ Not used for woodland
5/ Deep Granitic Soils
6/ Rocky Loam Foothills
7/ Indicates rating to be used when coloring single-purpose Interpretive maps

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TABLE 3

INDEX of SOIL MAPPING UNITS and INTERPRETIVE GROUPINGS

F.G. Stephens
Name L. W. Waterman Date Oct 1967

WORK UNIT or SURVEY AREA TULARE COUNTY GENERAL SOIL MAP Page 4 of 4

MAP SYMBOL	SOIL NAME	Percent 1/ of Association	INTERPRETIVE GROUPING AND SOIL LIMITATION RATINGS: Capability Unit		Vegetative Group	Hydrologic Group	Shrink-Swell Behavior	Septic Tank Filter Fields	Untreated Steel Pipe	Allowable Soil Pressure	Sewage Lagoons		Range Site	Woodland Suitability Group
			Irrigated	Dry							Impoundment	Embankment		
SH-AJ / E	Sheridan-Auberry association, 15 to 30 percent slopes													
	Sheridan	60		VIe17/	G	B7/	low7/	severe	low7/	moderate	severe	moderate7/	DGS8/	3/
	Auberry	25		VIs1	G	C	moderate	severe	moderate	moderate	severe	slight	DGS5/	3/
		(15)												
SH-AJ / F-2	Sheridan-Auberry association, 30 to 50 percent slopes, eroded													
	Sheridan	65		VIIe17/	J	B7/	low7/	severe	low7/	moderate	severe	moderate7/	DGS5/	3/
	Auberry	25		VIIs1	J	C	moderate	severe	moderate	moderate	severe	slight	DGS5/	3/
		(10)												
SL-Ah / EF	Sierra-Ahwahnee association, 15 to 50 percent slopes													
	Sierra	50		VIIs1	J	C7/	moderate7/	severe	moderate7/	moderate	severe	slight	DGS5/	3/
	Ahwahnee	45		VIIs1	J	B	low	severe	low	moderate	severe	moderate7/	DGS5/	3/
		(5)												
SL-AJ / EG	Sierra-Auberry association, 15 to 75 percent slopes													
	Sierra	50		VIIs1	J	C	moderate	severe	moderate	moderate	severe	slight	DGS5/	3/
	Auberry	45		VIIs1	J	C	moderate	severe	moderate	moderate	severe	slight	DGS5/	3/
		(5)												
SU / FG	Sites association, 30 to 75 percent slopes													
	Sites	85		VIIe1	J	C	moderate	severe	high	moderate	severe	moderate	2/	6
		(15)												
Vt-AJ / FG	Vista-Auberry association, 30 to 75 percent slopes													
	Vista	70		VIIs1	J	B7/	low7/	severe	low7/	moderate	severe	moderate7/	DGS5/	3/
	Auberry	25		VIIs1	J	C	moderate	severe	moderate	moderate	severe	slight	DGS5/	3/
		(5)												
GROUP 6- AREAS DOMINATED BY MISCELLANEOUS LAND TYPES														
RB-RL	Rough broken land- Rock land association													
	Rough broken land	70		VIIIe17/	J	D	--	--	--	--	--	--	RLF6/	3/
	Rock Land	20		VIIIs1	J	D	--	--	--	--	--	--	2/	3/
		(10)												
RW	Riverwash association													
	Riverwash	85		VIIIw4	J	D								
		(15)												

1/ Percent in (-) gives percent of other soils in the associations. (See descriptions)
2/ Not used for range
3/ Not used for woodland
5/ Deep Granitic Soils
6/ Rocky Loam Foot Hills
7/ Indicates rating to be used when coloring single-purpose Interpretive Maps

TABLE 4

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REV

TABLE OF SOIL CHARACTERISTICS AND QUALITIES

[redacted] TULARE COUNTY GENERAL SOIL MAP — Date 10/1967 — Prepared by E.C.Stephens- L.W. Waterman — Sheet 1 of 8

Map Symbol	Soil Name	Position	Profile (dry): Surface Layer	Profile (dry): Subsoil	Profile (dry): Substratum or Parent Material	Natural Drainage	Subsoil Perm	Runoff	Erosion Hazard	Effective Depth (inches)	A.W.C 1/ (inches)	Inherent Fertility	Present Land Use
GROUP 1 - AREAS DOMINATED BY MODERATELY DEEP TO VERY DEEP, NEARLY LEVEL, POORLY TO MODERATELY WELL DRAINED SALINE-ALKALI SOILS													
Eh	El Peco association	Old alluvial fans											
	El Peco		Very pale brown fine sandy loam, massive, hard, strongly alkaline	Very pale brown fine sandy loam, massive, hard, strongly alkaline	Light gray lime-silica hardpan, strongly alkaline	Somewhat poorly	Moderate to moderately rapid	Slow to very slow	None to slight	1[illegible]-36	4 to 5	Low	Cropland Pasture
Fv-Eh	Fresno-El Peco association	Basins and old alluvial fans											
	Fresno		Light gray to light brownish gray, fine sandy loam, massive, hard, strongly alkaline	Light brownish gray sandy clay loam, prismatic and blocky, very hard strongly alkaline	Light gray lime-silica hardpan, strongly alkaline.	Somewhat poorly	Moderately slow	Very slow	None to slight	20-36	4 to 5	Low	Cropland Pasture
	El Peco		Very pale brown fine sandy loam, massive, hard, strongly alkaline	Very pale brown fine sandy loam, massive, slightly hard, strongly alkaline	Light gray lime-silica hardpan, strongly alkaline	Somewhat poorly	Moderate to moderately rapid	Slow to very slow	None to slight	18-36	4 to 5	Low	Cropland Pasture
Gw-Fp	Grangeville-Foster Association	Alluvial fans and basins											
	Grangeville		Grayish brown fine sandy loam, granular, soft, mildly alkaline	Light brownish gray fine sandy loam, granular, soft, slightly mottled, mildly alkaline	Pale brown stratified fine sandy loam, loamy fine sand and loam, massive, soft, few mottles, strongly alkaline	Somewhat poorly	Moderate	Very slow to slow	None to slight	60+	5 to 7	Low	Cropland Pasture
	Foster		Gray sandy loam, massive in place, slightly hard, mildly to moderately alkaline	Light gray sandy loam, massive, slightly hard, few mottles, moderately alkaline	Light olive gray loamy sand, massive in place, slightly hard, moderately alkaline	Poorly to Very poorly	Moderate	Very slow	None to slight	60+	5 to 7	Moderate	Cropland Pasture
Ha-Wd	Hacienda-Waukena association	Old lake bed basins											
	Hacienda		Light gray sandy loam, massive, slightly hard, very strongly alkaline	Olive gray sandy clay loam, columnar, very hard, very strongly alkaline	Olive gray sandy clay loam or clay loam, fossil bearing lake bed deposits	Poorly	Slow	Slow	None to slight	60+	10 to 11	Low	Cropland
	Waukena		Light grey fine sandy loam, massive, slightly hard, mildly alkaline	Light yellowish brown sandy clay loam, columnar and blocky hard, very strongly alkaline	Light gray to light brownish grey stratified fine sandy loam and clay loam, massive, very strongly alkaline	moderately well to somewhat poorly	Slow to very slow	Slow	None to slight	60+	10 to 11	Low	Cropland
Hq-MM	Hilmar-Mocho	Old lake bed basins											
	Hilmar		Pale brown loamy sand, single grain, loose, mildly alkaline	Very pale brown loamy sand, single grain, loose, few mottles, very strongly alkaline	Light olive gray stratified, silt loam and fine sandy loam, strongly alkaline	Poorly to somewhat poorly	Moderate to slow	Slow to very slow	None to slight	60+	7 to 9	Low	Cropland Pasture
	Mocho		Grayish brown loam, granular, slightly hard, moderately alkaline	Light brownish gray loam, subangular blocky slightly hard, moderately alkaline	Light brownish gray, fine sandy loam, subangular blocky, slightly hard, moderately alkaline	Moderately well	Mod. slow to mod. rapid	Slow	None to slight	60+	8 to 10	Low	Cropland Pasture
Ls	Lewis association	Basins and valley plains											
	Lewis		Pale brown clay loam, blocky, strongly hard alkaline	Brown clay, blocky, very hard, strongly alkaline	Brown weakly cemented lime-silica hardpan, moderately alkaline	Somewhat poorly	Very slow	Slow	None to slight	30-60	4 to 11	High	Cropland Pasture

M-3070 1/ Total available water holding capacity within effective soil depth

TABLE 4

TABLE OF SOIL CHARACTERISTICS AND QUALITIES

CF-77
REV -66

SURVEY AREA or WORK UNIT TULARE COUNTY GENERAL SOIL MAP   Date 10/1967   Prepared by F.C. Stephens - L.W. Waterman   Sheet 2 of 8

Map Symbol	Soil Name	Position	Profile (dry) Surface Layer	Profile (dry) Subsoil	Profile (dry) Substratum or Parent Material	Natural Drainage	Subsoil Perm	Runoff	Erosion Hazard	Effective Depth (inches)	AWC 1/ (inches)	Inherent Fertility	Present Land Use
MA-Ru	Merced-Rossi	Old lake bed basins											
	Merced		Very dark gray, clay loam, blocky, very hard, strongly alkaline	Olive brown sandy clay, blocky, very hard, moderately alkaline	Light yellowish brown sandy loam, massive, slightly hard, mildly alkaline	Poorly	Slow	Slow	None to slight	60+	10 to 11	High	Cropland Pasture
	Rossi		Grayish brown, loam subangular blocky, hard, moderately alkaline	Light brownish gray clay loam, subangular blocky very hard, mottled, strongly alkaline	Pale yellow stratified sediments, massive, very hard, strongly alkaline	Poorly	Slow	Slow	None to slight	60+	10 to 11	High	Cropland Pasture
Ti-Tx	Temple-Traver association	Basins											
	Temple		Dark gray loam, massive hard, slightly acid	Light olive gray clay loam, blocky, hard, mottled moderately alkaline	Pale olive stratified fine sandy loam and sandy clay loam, massive, hard, moderately alkaline	Somewhat poorly	Moderately slow to slow	Very slow	None to slight	60+	10 to 11	Moderate	Cropland
	Traver		Light brownish gray, fine sandy loam, massive, hard moderately alkaline	Light brownish gray, fine sandy loam, subangular blocky, very strongly alkaline	Very pale brown fine sandy loam, stratified, massive hard, few mottles, strongly alkaline	Somewhat poorly	Moderately slow	Slow	None to slight	60+	8 to 10	Moderate	Cropland Pasture
Tx-PH	Traver-Pond association	Alluvial fans and basins											
	Traver		Light brownish gray fine sandy loam, massive, hard moderately alkaline	Light brownish gray fine sandy loam, subangular blocky, very hard, strongly alkaline	Very pale brown fine sandy loam, stratified, massive, hard, few mottles, strongly alkaline	Somewhat poorly	Moderately slow	Slow	None to slight	60+	8 to 10	Moderate	Cropland Pasture
	Pond		Light brownish gray clay loam, blocky, slightly hard strongly alkaline	Very pale brown sandy clay loam, massive, extremely hard, strongly alkaline	Very pale brown sandy loam, massive, moderately alkaline	Somewhat poorly	Moderately slow to slow	Slow to very slow	None to slight	60+	9 to 11	Moderate	Cropland Pasture
GROUP 2 - AREAS DOMINATED BY VERY DEEP, NEARLY LEVEL TO GENTLY SLOPING, MODERATELY WELL TO EXCESSIVELY DRAINED SOILS													
Cu-LR / AB	Chualar-Los Robles association, 0 to 5 percent slopes	Alluvial fans											
	Chualar		Dark grayish brown sandy loam, granular, slightly hard, slightly acid	Brown sandy clay loam, blocky, hard, neutral to mildly alkaline	Brown sandy loam, massive, hard, mildly alkaline	Well	Moderately slow	Slow	Slight	60+	10 to 12	Moderate	Citrus Dry Pasture
	Los Robles		Brown clay loam, massive hard, neutral	Brown clay loam, massive hard neutral	Brown clay loam, massive hard, neutral	Well to moderately well	Moderately to moderately slow	Slow	Slight	60+	10 to 12	Moderate	Citrus Dry Pasture
Dg-Cf	Delhi-Calhi association	Alluvial fans											
	Delhi		Pale brown, sand, single grain, loose, slightly acid	Pale brown sand, single grain, loose, slightly acid	Light yellowish brown sand, single grain, loose slightly acid	Somewhat excessively to excessively	Very rapid	Very slow	Water-none to slight wind-moderate	60+	2 to 3	Low	Cropland Vineyard
	Calhi		Pale brown loamy fine sand, single grain, loose, moderately alkaline	Pale brown loamy, fine sand, single grain, loosely strongly alkaline	Pale brown loamy fine sand, single grain, loose, strongly alkaline	Somewhat excessively to excessively	Very rapid	Very slow	Water -none to slight wind-moderate	60+	3 to 5	Low	Cropland Vineyard

M-3070   1/ Total available water holding capacity within effective soil depth

TABLE 4

CF-77
REV 1-66

TABLE OF SOIL CHARACTERISTICS AND QUALITIES

SURVEY AREA or WORK UNIT TULARE COUNTY GENERAL SOIL MAP | Date 10/1967 | Prepared by E.G. Stephens - L.W. Waterman | Sheet 3 of 8

Map Symbol	Soil Name	Position	Profile (dry): Surface Layer	Profile (dry): Subsoil	Profile (dry): Substratum or Parent Material	Natural Drainage	Subsoil Perm	Runoff	Erosion Hazard	Effective Depth (inches)	AWC 1/ (inches)	Inherent Fertility	Present Land Use
Gx-Hd / AB	Greenfield-Hanford association 0 to 5 percent slopes	Terraces, alluvial fans and valley fill											
	Greenfield		Pale brown coarse sandy loam, massive, slightly hard, slightly acid	Light yellowish brown fine sandy loam, subangular blocky, slightly hard neutral	Brownish yellow stratified loamy sand, sandy loam and fine sandy loam, massive, soft, neutral	Well	Moderately rapid to rapid	Slow to medium	Slight	60+	10 to 14	Moderate	Cropland Vineyard
	Hanford		Pale brown fine sandy loam, granular, slightly hard, slightly acid to neutral	Pale brown fine sandy loam, massive, slightly hard, neutral	Pale brown or very pale brown stratified fine sandy loam and loamy sand, massive, slightly hard, mildly alkaline	Well to somewhat excessively	Moderately rapid	Very slow to slow	Slight	60+	8 to 10	Moderate	Cropland Vineyard
Hd-Hl	Hanford-Hesperia association	Alluvial fans and valley											
	Hanford		Pale brown fine sandy loam, granular, slightly hard, slightly acid to neutral	Pale brown fine sandy loam, massive, slightly hard, neutral	Pale brown or very pale brown stratified fine sandy loam and loamy sand, massive, slightly hard, alkaline	Well to somewhat excessively	Moderately rapid	Very slow to slow	None to slight	60+	8 to 10	Moderate	Cropland vineyard
	Hesperia		Brown sandy loam, massive, hard, mildly alkaline	Brown sandy loam, massive slightly hard, moderately alkaline	Pale brown loam and sandy loam, massive, hard, moderately alkaline	Somewhat excessively	Moderately rapid	Slow	None to slight	60+	8 to 10	Moderate	Cropland vineyard
Hl-Fp	Hesperia-Foster association	Alluvial fans, valley fill and basins											
	Hesperia		Brown sandy loam, massive, hard, mildly alkaline	Brown, sandy loam, massive slightly hard, moderately alkaline	Pale brown loam and sandy loam, massive, hard, moderately alkaline	Somewhat excessively	Moderately rapid	Slow	None to slight	60+	8 to 10	Moderate	Cropland vineyard
	Foster		Gray and light gray sandy loam, massive in place, slightly hard, mildly to moderate alkaline	Light gray sandy loam, massive, slightly hard, few mottles, moderately alkaline	Light olive gray loamy sand, massive in place, slightly hard, moderately alkaline	Moderately well	Moderate	Very slow	None to slight	60+	8 to 10	Moderate	Cropland vineyard
Hl-Hd	Hesperia-Hanford association	Alluvial fans and valley fill											
	Hesperia		Brown sandy loam, massive, hard, mildly alkaline	Brown, sandy loam, massive, slightly hard, moderately alkaline	Pale brown loam and sandy loam, massive, hard, moderately alkaline	Somewhat excessively	Moderately rapid	Slow	None to slight	60+	8 to 10	Moderate	Cropland vineyard
	Hanford		Pale brown fine sandy loam, granular, slightly hard, slightly acid to neutral	Pale brown fine sandy loam, massive, slightly hard, neutral	Pale brown or very pale brown stratified fine sandy loam and loamy sand, massive, slightly hard, mildly alkaline	Well to somewhat excessively	Moderately rapid	Very slow to slow	None to slight	60+	8 to 10	Moderate	Cropland vineyard
TD-Gw	Tujunga-Grangeville association	Alluvial fans and basins											
	Tujunga		Pale brown sand, single grain, loose, slightly acid to neutral	Pale brown sand, single grain, loose, slightly acid to neutral	Stratified sand, coarse sand and gravel, single grain, neutral	Somewhat excessively	Rapid to very rapid	Slow	None to slight	60+	2 to 3	Low	Pasture Cropland
	Grangeville		Grayish brown fine sandy loam, granular, soft, mildly alkaline	Light brownish gray fine sandy loam, granular, soft, few mottles, mildly alkaline	Pale brown stratified fine sandy loam, loamy fine sand and loam, massive, soft, few mottles, strongly alkaline	Moderately well	Moderate	Very slow to slow	None to slight	60+	5 to 7	Low	Pasture Cropland
Vs-Hl / AB	Visalia-Hesperia association, 0 to 5 percent slopes	Alluvial fans, basins and valley fill											
	Visalia		Gray to dark gray fine sandy loam, massive, slightly hard, neutral	Grayish brown fine sandy loam, massive, slightly hard, mildly alkaline	Brown stratified sandy loam and fine sandy loam, massive, slightly hard, moderately alkaline	Moderately well	Moderately rapid to rapid	Slow to medium	Slight	60+	5 to 7	Moderate	Cropland citrus

M-3070 1/ Total available water holding capacity within effective soil depth

TABLE 4

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TABLE OF SOIL CHARACTERISTICS AND QUALITIES

SURVEY AREA or WORK UNIT TULARE COUNTY GENERAL SOIL MAP   Date 10/1967   Prepared by F.G. Stephens - L.D. Waterman   Sheet 4 of 8

Map Symbol	Soil Name	Position	Profile (dry) Surface Layer	Subsoil	Substratum or Parent Material	Natural Drainage	Subsoil Perm	Runoff	Erosion Hazard	Effective Depth (inches)	AWC (inches) 1/	Inherent Fertility	Present Land Use
	Hesperia		Brown sandy loam, massive, hard, mildly alkaline	Brown sandy loam, massive, slightly hard, moderately alkaline	Pale brown loam and sandy loam, massive, hard, moderately alkaline	Somewhat excessively	Moderately rapid	Low	Slight	60+	[illegible] to 1	Moderate	Cropland Vineyards
GROUP 3 -	AREAS DOMINATED BY MODERATELY DEEP, NEARLY LEVEL WELL DRAINED SOILS WITH HARDPANS												
Si-Ex	San Joaquin-Exeter association	Basins, alluvial fans and low terraces											
	San Joaquin		Yellowish red sandy loam, massive, very hard, medium acid	Reddish, yellow sandy clay, blocky, extremely hard, slightly acid	Reddish yellow hardpan	Well	Very Slow	Slow	None to slight	20 to 36	[illegible] to 3	Moderate	Cropland Orchards Pasture Vineyards
	Exeter		Light brownish gray and brown fine sandy loam, massive, slightly hard, slightly acid	Brown loam, massive, slightly hard, slightly acid	Reddish brown hardpan, mildly alkaline	Well	Moderate	Slow	None to slight	20 to 36	2 to 4	Moderate	Cropland Orchards Pasture Vineyards
GROUP 4 -	AREAS DOMINATED BY MODERATELY PERMEABLE SOILS	DEEP TO VERY DEEP, NEARLY LEVEL TO MODERATELY SLOPING, MODERATELY WELL TO WELL DRAINED, SLOWLY TO VERY SLOWLY											
Dy/BC	Ducor association 2 to 9 percent slopes	Terraces and alluvial fans											
	Ducor		Brown clay, prismatic, very hard, moderately alkaline	Brown clay, blocky or massive, very hard, many mottles, moderately alkaline	Yellowish brown fine sandy loam, massive, hard, moderately alkaline	Moderately well to well	Slow to very slow	Slow to medium	Slight to moderate	60+	10 to 12	High	Cropland Range
Pl-Cy/AC	Porterville-Centerville association, 0 to 9 percent slopes	Alluvial fans and terraces											
	Porterville		Dark reddish brown clay, blocky, very hard, neutral	Dark reddish gray and dark brown clay, blocky, very hard, mildly to moderately alkaline	Dark brown clay, massive, very hard, moderately alkaline	Well	Slow	Slow to medium	Slight to moderate	60+	9 to 11	High	Citrus Pasture
	Centerville		Dark gray to dark reddish brown clay, blocky, very hard, slightly acid	Dark reddish brown clay, blocky, very hard, mildly alkaline	Cobbles and gravel of metamorphic and basic igneous rocks	Well	Slow to very slow	Slow	Slight to moderate	20-36	7 to 8	High	Pasture
GROUP 5 -	AREAS DOMINATED BY SHALLOW TO DEEP, STRONGLY SLOPING TO VERY STEEP, WELL TO EXCESSIVELY DRAINED UPLAND SOILS												
Ah-AJ/EF-2	Ahwahnee-Auberry association, 15 to 50 percent slopes, eroded	Mountainous uplands											
	Ahwahnee		Grayish brown coarse sandy loam, granular, slightly hard, slightly acid	Brown to pale brown coarse sandy loam, subangular, blocky, hard slightly acid	Weathered acid igneous rock	Well to somewhat excessively	Moderately rapid to rapid	Rapid	High	20-36	3 to 5	Moderate	Range
	Auberry		Grayish brown coarse sandy loam, granular, slightly hard, slightly acid	Brown light sandy clay loam, blocky, very hard, strongly acid	Strongly weathered acid igneous rock	Well to somewhat excessively	Moderate to moderately slow	Rapid	High	20-36	3 to 6	Moderate	Range
Ah-SL/DE-2	Ahwahnee-Sierra association, 9 to 30 percent slopes, eroded	Mountainous uplands											
	Ahwahnee		Grayish brown coarse sandy loam, granular, slightly hard, slightly acid	Brown to pale brown coarse sandy loam, subangular blocky, hard, slightly acid	Weathered acid igneous rock	Well to somewhat excessively	Moderately rapid to rapid	Medium to rapid	High	20-36	3 to 5	Moderate	Range
	Sierra		Brown coarse sandy loam, massive, slightly hard, medium acid	Red clay loam, massive, very hard, slightly acid	Strongly weathered acid igneous rock	Well	Moderate to moderately slow	Medium to rapid	High	20-36	3 to 6	Moderate	Range

M-3070 1/ Total available water holding capacity within effective soil depth

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TABLE OF SOIL CHARACTERISTICS AND QUALITIES

SURVEY AREA or WORK UNIT TULARE COUNTY GENERAL SOIL MAP Date 10/1967 Prepared by F.G. Stephens - L.A. Waterman Sheet 5 of 8

Map Symbol	Soil Name	Position	Profile (dry) Surface Layer	Subsoil	Substratum or Parent Material	Natural Drainage	Subsoil Perm	Runoff	Erosion Hazard	Effective Depth (inches)	AWC 1/ (inches)	Inherent Fertility	Present Land Use
Ah-Vt / FG	Ahwahnee-Vista association, 30 to 75 percent slopes	Mountainous uplands											
	Ahwahnee		Grayish brown coarse sandy loam, granular, slightly hard, slightly acid	Brown to pale brown coarse sandy loam, subangular blocky, hard, slightly acid	Weathered acid igneous rock	Well to somewhat excessively	Moderately rapid to rapid	Rapid	High	20-36	3 to 5	Moderate	Range
	Vista		Dark grayish brown to dark brown coarse sandy loam, granular, slightly hard, neutral	Brown to yellowish brown coarse sandy loam, massive, hard, slightly acid	Weathered acid igneous rock	Well to somewhat excessively	Moderately rapid	Rapid	High	20-36	3 to 6	Moderate	Range
Au-Vt / E	Auberry-Vista association, 15 to 30 percent slopes	Mountainous uplands											
	Auberry		Grayish brown coarse sandy loam, slightly hard, granular, slightly acid	Brown light sandy clay loam, blocky, very hard, strongly acid	Strongly weathered acid igneous rock	Well to somewhat excessively	Moderate to moderately slow	Medium to rapid	Moderate	20-36	3 to 6	Moderate	Range
	Vista		Dark grayish brown to dark brown coarse sandy loam, granular, slightly hard, neutral	Brown to yellowish brown coarse sandy loam, massive, hard, slightly acid	Weathered acid igneous rock	Well to somewhat excessively	Moderately rapid	Medium to rapid	Moderate	20-36	3 to 6	Moderate	Range
CJ-Tv / EF	Cibo-Trabuco association, 15 to 50 percent slopes	Mountainous uplands											
	Cibo		Dark brown stony clay, subangular blocky, hard, slightly acid	Brown very stony clay, blocky, very hard, mildly alkaline	Fractured and weathered basic igneous rock	Well	Moderately slow to slow	Medium to rapid	Moderate to high	10-36	3 to 7	Moderate	Range
	Trabuco		Brown loam, massive, hard, slightly acid	Reddish brown clay, blocky, very hard, neutral	Slightly weathered basic igneous rock	Well to somewhat excessively	Slow	Medium to rapid	Moderate to high	20-36	5 to 7	Moderate	Range
CQ-Fw / FG	Coarsegold-Friant association, 30 to 75 percent slopes	Mountainous uplands											
	Coarsegold		Brown loam, massive, slightly hard, slightly acid	Reddish brown gravelly clay loam, blocky, very hard neutral to slightly acid	Weathered metasedimentary rock	Well to somewhat excessively	Moderately slow	Rapid	High	20-36	3 to 6	Moderate	Range
	Friant		Brown fine sandy loam, granular, slightly hard, slightly acid	Brown fine sandy loam, massive, slightly hard, neutral	Slightly weathered quartz mica schist	Well to somewhat excessively	Moderate to moderately rapid	Rapid	High	10-20	1 to 3	Moderate	Range
Hs-SC / FG-2	Holland-Shaver association, 30 to 75 percent slopes eroded	Mountainous uplands											
	Holland		Dark grayish brown and dark brown loam, slightly hard, granular, medium to slightly acid	Brown and reddish brown sandy clay loam or clay loam, hard, subangular blocky, slightly to medium acid	Strongly weathered acid igneous rock	Well to somewhat excessively	Moderately slow	Rapid	High	20-36	3 to 6	Moderate	Forest

M-3070 1/ Total available water holding capacity within effective soil depth

TABLE 4

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TABLE OF SOIL CHARACTERISTICS AND QUALITIES

SURVEY AREA or WORK UNIT Tulare County General Soil Map   Date 10/1967   Prepared by F.C. Stephens- L.W. Waterman   Sheet 6 of 8

Map Symbol	Soil Name	Position	Profile (dry): Surface Layer	Profile (dry): Subsoil	Profile (dry): Substratum or Parent Material	Natural Drainage	Subsoil Perm	Runoff	Erosion Hazard	Effective Depth (inches)	A.W.C. (inches) 1/	Inherent Fertility	Present Land Use
	Shaver		Dark grayish brown and grayish brown coarse, sandy loam, crumb, soft, slightly acid	Pale brown coarse sandy loam, massive, slightly hard, medium acid	Strongly weathered acid igneous rock	Well to somewhat excess-ively	Moderate-ly rapid to rapid	Rapid	High	20-36	2 to 5	Moderate	Forest
Hs-sm / G	Holland-Stump Springs association, 50 to 75 percent slopes	Mountainous uplands											
	Holland		Dark grayish brown and dark brown loam, granular, slightly hard, medium to slightly acid	Brown and reddish brown sandy clay loam or clay loam, hard, subangular, blocky, slightly to medium acid	Strongly weathered acid igneous rock	Well to somewhat excess-ively	Moderate-ly slow	Rapid	High	20-36	3 to 6	Moderate	Forest
	Stump Springs		Grayish brown and very pale brown coarse sandy loam, granular, slightly acid, slightly hard	Light yellowish brown heavy sandy clay loam, blocky, very hard, strongly acid	Strongly weathered acid igneous rock	Well	Slow	Rapid	High	20-36	2 to 5	Moderate	Forest
Li / F	Las Posas association, 30 to 50 percent slopes	Mountainous uplands											
	Las Posas		Reddish brown loam, granular, hard, slightly acid	Dark red clay, blocky, very hard, neutral	Weathered basic igneous rock	Well	Slow to moderate-ly slow	Rapid	High	20-36	6 to 8	Moderate	Range
ms-CA / FG-2	Musick-Chawanakee association, 30 to 75 percent slopes, eroded	Mountainous uplands											
	Musick		Grayish brown loam, granular, slightly hard, slightly acid	Red heavy clay loam, prismatic, very hard, medium acid	Strongly weathered acid igneous rock	Well	Moderate to moder-ately slow	Rapid	High	20-36	3 to 6	Moderate	Forest
	Chawanakee		Grayish brown coarse sandy loam, granular, slightly hard, medium acid	Very pale brown coarse sandy loam, granular or massive, hard medium acid	Strongly weathered acid igneous rock	Well to excess-ively	Moderately rapid	Rapid	High	20-36	3 to 5	Moderate	Forest
SC-sm / G	Shaver-Stump Spring association, 50 to 75 percent slopes	Mountainous uplands											
	Shaver		Dark grayish brown and grayish brown coarse sandy loam, crumb, soft, slightly acid	Pale brown coarse sandy loam, massive, slightly hard, medium acid	Strongly weathered acid igneous rock	Well to somewhat excess-ively	Moderate-ly rapid to rapid	Rapid	High	20-36	2 to 5	Moderate	Forest
	Stump Springs		Grayish brown and very pale brown coarse sandy loam, granular, slightly hard, slightly acid	Light yellowish brown heavy sandy clay loam, blocky, very hard, strong-ly acid	Strongly weathered acid igneous rock	Well	Slow	Rapid	High	20-36	2 to 5	Moderate	Forest
SH-AJ / E	Sheridan-Auberry association 15 to 30 percent slopes	Mountainous uplands											
	Sheridan		Dark grayish brown loam, granular, slightly hard, slightly acid	Dark grayish brown loam, subangular blocky, slightly hard, slightly acid	Strongly weathered acid igneous rock	Well to somewhat excess-ively	Moderate to mod. rapid	Medium	Moderate	20-36	3 to 6	Moderate	Range
	Auberry		Grayish brown coarse sand loam, granular, slight-ly hard, slightly acid	Brown light sandy clay loam, blocky, very hard, strongly acid	Strongly weathered acid igneous rock	Well to somewhat excess-ively	Moderate to moder-ately slow	Medium	Moderate	20-36	3 to 6	Moderate	Range

M-3070 1/ Total available water holding capacity within effective soil depth

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TABLE OF SOIL CHARACTERISTICS AND QUALITIES

SURVEY AREA or WORK UNIT TULARE COUNTY GENERAL SOIL MAP Date 10/1967 Prepared by F.G. Stephens - L.W. Waterman Sheet 7 of 8

Map Symbol	Soil Name	Position	Profile (dry)			Natural Drainage	Subsoil Perm.	Runoff	Erosion Hazard	Effective Depth (inches)	A.W.C. 1/ (inches)	Inherent Fertility	Present Land Use
			Surface Layer	Subsoil	Substratum or Parent Material								
SH-AJ / F-2	Sheridan-Auberry association, 30 to 50 percent slopes, eroded	Mountainous uplands											
	Sheridan		Dark grayish brown loam, granular, slightly hard, slightly acid	Dark grayish brown loam subangular blocky, slightly acid and slightly hard	Strongly weathered acid igneous rock	Well to somewhat excessively	Moderate to mod. slow	Rapid	High	20-36	3 to 6	Moderate	Range
	Auberry		Grayish brown coarse sandy loam, granular, slightly hard, slightly acid	Brown light sandy clay loam, blocky, very hard, strongly acid	Strongly weathered acid igneous rock	Well to somewhat excessively	Moderate to moderately slow	Rapid	High	20-36	3 to 6	Moderate	Range
SL-Ah / EF	Sierra-Ahwahnee association 15 to 50 percent slopes	Mountainous uplands											
	Sierra		Brown coarse sandy loam, massive, slightly hard, medium acid	Red clay loam, massive, very hard, slightly acid	Strongly weathered acid igneous rock	Well to somewhat excessively	Moderate to moderately slow	Medium to rapid	Moderate to high	20-36	3 to 6	Moderate	Range
	Ahwahnee		Grayish brown coarse sandy loam, granular, slightly hard, slightly acid	Brown to pale brown coarse sandy loam, subangular blocky, hard, slightly acid	Weathered acid igneous rock	Well to somewhat excessively	Moderately rapid to rapid	Medium to rapid	Moderate to high	20-36	3 to 5	Moderate	Range
SL-AJ / EG	Sierra-Auberry association, 15 to 75 percent slopes	Mountainous uplands											
	Sierra		Brown coarse sandy loam, massive, slightly hard, medium acid	Red clay loam, massive, very hard, slightly acid	Strongly weathered acid igneous rock	Well	Moderate to moderately slow	Medium to rapid	Moderate to high	20 to 36	3 to 6	Moderate	Range
	Auberry		Grayish brown coarse sandy loam, granular, slightly acid	Brown light sand, clay loam, blocky, very hard, strongly acid	Strongly weathered acid igneous rock	Well to somewhat excessively	Moderate to moderately slow	Rapid	Moderate to high	20 to 36	3 to 6	Moderate	Range
SQ / FG	Sites association, 30 to 75 percent slopes	Mountainous uplands											
	Sites		Brown loam, granular, slightly hard, slightly acid	Red clay, angular and subangular blocky, hard, strongly acid	Weathered metamorphic rock	Well	Moderately slow to slow	Rapid	High	36-60	6 to 9	High	Forest
Vt-AJ / FG	Vista-Auberry association, 30 to 75 percent slopes	Mountainous uplands											
	Vista		Dark grayish brown to dark brown coarse sandy loam, granular, slightly hard, neutral	Brown to yellowish brown coarse sandy loam, massive, hard, slightly acid	Weathered acid igneous rock	Well to somewhat excessively	Moderately rapid	Rapid	High	20-36	3 to 6	Moderate	Range
	Auberry		Grayish brown coarse sandy loam, granular, slightly hard, slightly acid	Brown light sandy clay loam, blocky, very hard, strongly acid	Strongly weathered acid igneous rock	Well to somewhat excessively	Moderate to moderately slow	Rapid	High	20-36	3 to 6	Moderate	Range

M-3070 1/ Total available water holding capacity within effective soil depth

TABLE 4

TABLE OF SOIL CHARACTERISTICS AND QUALITIES

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SURVEY AREA or WORK UNIT TULARE COUNTY GENERAL SOIL MAP

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Map Symbol	Soil Name	Position	Profile (dry) Surface Layer	Subsoil	Substratum or Parent Material	Natural Drainage	Subsoil Perm	Runoff	Erosion Hazard	Effective Depth (inches)	A.W.C. 1/ (inches)	Inherent Fertility	Present Land Use
GROUP 6 -	AREAS DOMINATED BY MISCELLANEOUS LAND TYPES												
RB-RL	Rough broken land - Rock land association												
	Rough broken land	Very steep land, ordinarily not stony, broken by intermittent drainage channels and local relief generally between 25 and 500 feet. Runoff is high and geologic erosion is active; grass and scattered brush											
	Rock land	Over 25 percent rock outcrop with very little soil material; scattered grass, brush and trees.											
RW	Riverwash association												
	Riverwash	Land subject to periodic overflow, has little or no vegetation and little or no agricultural value.											

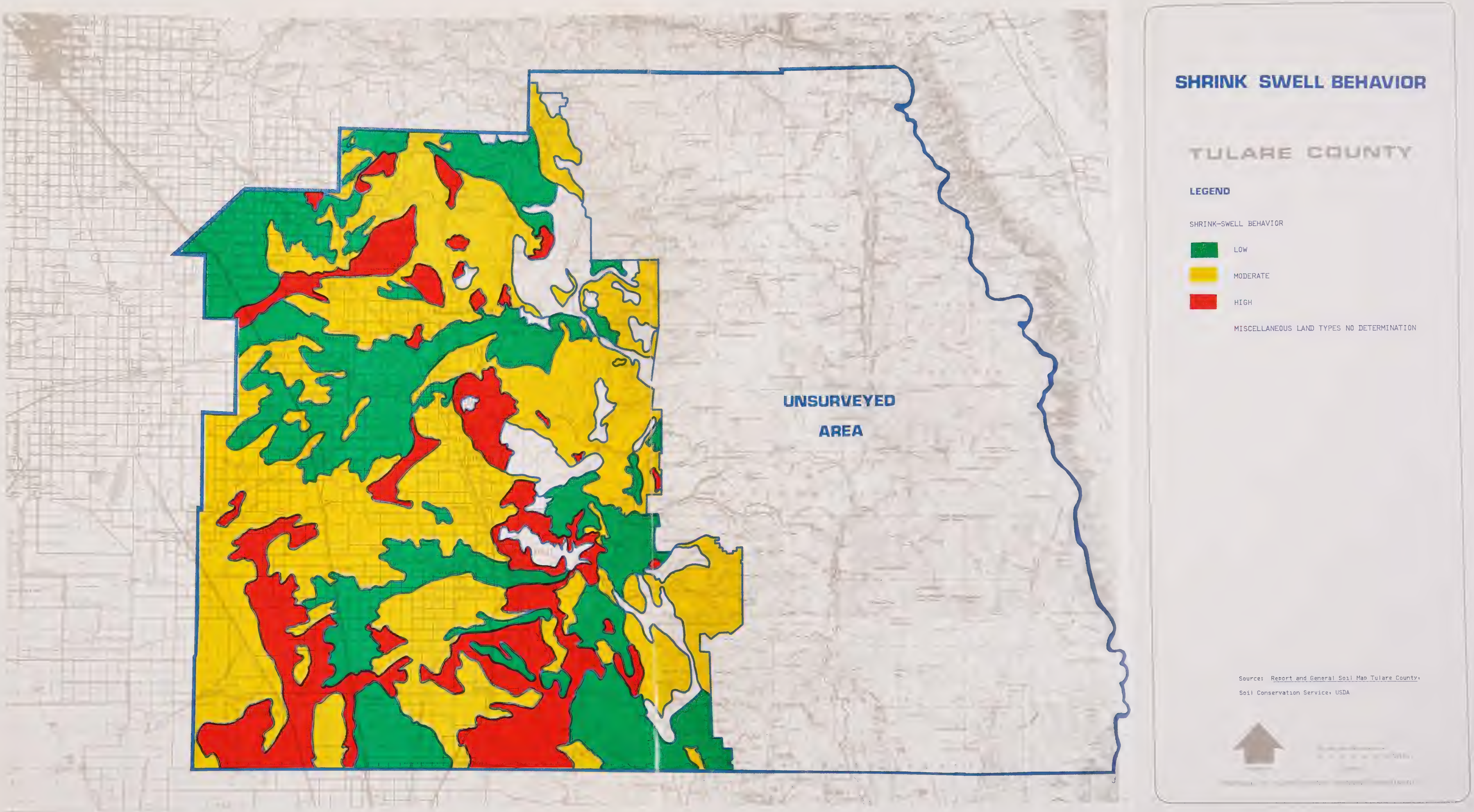
M-3070 1/ Total available water holding capacity within effective soil depth

SHRINK-SWELL BEHAVIOR

Shrink-swell behavior is that quality of the soil that determines its volume change with change in moisture content. Building foundations, roads, and other man-made structures may be severely damaged by the continuous shrinking and swelling of the soil. The volume change is influenced by two factors: (1) the amount of moisture change within an area, and (2) the amount and kind of fine textured clay in the soil.

The map shows that shrink-swell conditions vary considerably from place to place in the County. In general, severe shrink-swell behavior can be identified or associated with four general areas: (1) the discontinuous belt of fine textured clays which can be found along the base of the foothills; (2) areas which fringe upon the old Tulare Lake bed; (3) areas which lie within and adjacent to Lewis, Cross, and Cottonwood Creeks; (4) small pockets of fine textured clays found within some of the mountain valleys of the County.

This interpretive map can be of great value to building officials when determining foundation requirements throughout the County. Furthermore, this map could be used as a basis for developing overlay zones pursuant to the regulations discussed in Chapter VII.



UNSURVEYED
AREA
SHRINK SWELL BEHAVIOR
TULARE COUNTY
LEGEND
SHRINK-SWELL BEHAVIOR
LOW
MODERATE
HIGH
MISCELLANEOUS LAND TYPES NO DETERMINATION
Source: Report and General Soil Map Tulare County,
Soil Conservation Service, USDA

A. URBAN DEVELOPMENT

Soil interpretations for urban development are based upon two general considerations: (1) the suitability of the site for foundation support and increased density of development (i.e., bearing strength, shrink-swell behavior, flooding potential, etc.) and; (2) an analysis of the ability of the soil in the surrounding area to withstand the impact of urbanization (drainage characteristics, erosion hazards, etc). In addition, in those areas where municipal or community sewer are not available, the suitability of the soil for septic tank filter fields becomes important.

In this section, urban development is divided into two classifications based upon the intensity of the urban activity. Residential development (low intensity) and, commercial-industrial use (high intensity). However, soil ratings for these uses do not consider such factors as location, water supply, accessibility or other practical or esthetic features of a given site. Thus, although a particular soil type may retain few limitations for urbanization, this does not necessarily mean that urbanization must or should occur there. There are many other determinants that, in addition to soil factors, must be considered before the final suitability of a given site may be ascertained.

A-1 RESIDENTIAL DEVELOPMENT (low intensity)

As used in this context, residential or low intensity development is defined rather broadly. It could embrace any single family residence at any location as well as multiple family and high density development. It is generally assumed that the density of population in these residential areas is not high and that building heights will generally be less than three stories. It is further assumed, because of coverage limitations in local zoning laws, that the intensity of site utilization will not be total and that considerable areas will therefore remain in open or landscaped areas.

Soil limitation ratings for residential development have been combined from various individual ratings of specific soil characteristics. These include: allowable soil pressure and shrink-swell behavior as an indication of foundation support; landscaping suitability ratings as an indication of the ability of the soil to produce grass and shrubs; erosion hazard ratings as an indication of impact potential on the surrounding area; the degree of slope as an indication of the extent of site preparation which is necessary; and, natural drainage characteristics and flooding potential as an indication of the hazards of overland flow in the area.

The most critical impact on soils by residential development occurs during the construction of individual homes. During this period the soils on the site may remain unprotected anywhere from three to twelve months. Thus, in sloping topography, the susceptibility of soils to erosion and mass movement is a major consideration. Scrap construction materials from building operations, grade alterations and heavy wheeled vehicles may severely destroy soil capabilities for future landscaping or gardening.

Degree of Limitation:

Slight- soils having less than 3% slopes; more than 2,000 lbs. per square inch allowable soil pressure; moderately well to somewhat excessive natural drainage; a flooding or ponding potential of less than once in one hundred years; none or slight erosion hazards; low shrink-swell behavior; slight limitations for landscaping.

Moderate - soils having between 3-12% slopes; between 2,000 to 1,000 lbs. per square inch allowable soil pressure; excessive or somewhat poor natural drainage; a flooding or ponding potential of not more than once in one hundred years, or subject to sheet flow; moderate erosion hazards; moderate shrink-swell behavior; moderate limitations for landscaping.

Severe - soils having more than 12% slopes; less than 1,000 lbs. per square inch allowable soil pressure; poor to very poor natural drainage; a flooding or ponding potential of more than once in one hundred years; high or very high erosion hazards; severe shrink-swell behavior; severe limitations for landscaping.

Where municipal or community sewers are unavailable, the soil limitation ratings for septic tank filter fields should be added to the above classifications. The criteria used to rate soils for septic tank filter fields are found on page 56.

A-2 COMMERCIAL AND INDUSTRIAL DEVELOPMENT (high intensity)

Commercial and industrial development generally involve an intense use of the land. In some areas the entire site may be used or modified for use so that the original soil surface is often completely covered. Usually most of the soil in the site is modified. It is generally assumed that the buildings involved are less than three stories in height with a minimum of 2,500 square feet on each floor. Commercial and industrial areas often generate high activity with heavy auto traffic. Thus, the need for extensive paved auto parking areas is commonly associated with these areas.

Soil limitation ratings for commercial and industrial development are similar to those for residential areas. However, because site utilization is generally more intense, the potential of the area for producing increased surface runoff takes on greater importance. Similarly, topographical characteristics are more restrictive due to the extensive site preparation necessary for such uses. Although it is assumed that site accessibility is not a problem, any full site evaluation should also include a soil suitability analysis for paved parking areas (similar to the criteria described in subsections D-1 and F-3 of this chapter). Finally the high activity level normally associated with commercial and industrial development necessitates careful evaluation of flooding potential.

(See Degree of Limitation for A-2 on p.56-A)

B. WASTE DISPOSAL FACILITIES

Soils are rated for their suitability for three forms of waste disposal facilities: septic tank filter fields, sewage lagoons and solid waste disposal areas. As previously noted, the soil suitability ratings for septic tank filter fields should be combined with other soil factors in assessing the soil capability for urban development in unsewered areas of the County.

The basic soil considerations for these types of facilities require a determination of the capability of the soil to efficiently filter or biologically alter harmful substances from the waste products and prevent groundwater pollution. Thus, soil characteristics which are considered include - textures, permeability and percolation rates, slopes, soil depths, depth to seasonal and permanent groundwater, flooding or ponding potential, drainage characteristics, and biological response.

B-1 SEPTIC TANK FILTER FIELDS

The usual form of on-site sewage disposal in unsewered areas of the County is the septic tank and filter field system. A septic tank is an underground container which conditions sewage effluent so that it may be percolated easily into the subsoil. Percolation of the effluent is usually accomplished through a filter field or seepage bed. Leach pits are sometimes used, but are generally considered to be more hazardous.

Unfortunately, septic tanks are not very effective in the removal of micro-organisms from the sewage. Thus, although the sewage undergoes partial stabilization in passing through the tank, not all of the disease-producing agents are removed; hence, septic tank effluents cannot be considered "safe" from a health standpoint.

The effluent is further treated by passage through the soil, which filters and absorbs certain pollutants, as well as assists in further removing any suspended solids by filtration. The soil will not remove certain dissolved solids or micro-organisms. Some disease-producing micro-organisms which require special conditions for life, such as the warmth found within a human or other warm-blooded animal host, will, however, die, given enough time. Some organisms are destroyed by biological agents in the soil. The rate at which the soil absorbs effluent is critical to the proper operation of the sewage disposal system.

The permeability of the soil is, thus, one of the most important soil characteristics affecting proper absorption. If the effluent is not absorbed rapidly enough, it may back up or rise to the surface of the ground. If the effluent drains through the soil too rapidly, it may travel unfiltered into groundwater supplies and contaminate them. In either event, the presence of effluent on the surface or in the groundwater constitutes a potential public health hazard.

Thin soils or proximity to bedrock also poses severe problems for septic tank sewage disposal systems. Where soils are shallow, there is insufficient depth for the necessary filtering action. Thus,the effluent may reach bedrock level in a relatively raw state. Where the bedrock is solid or impervious, the force of gravity will gradually transport the effluent until it finds a fissure in the rock or comes to the surface. Where bedrock is fractured or permeable, it may contribute to groundwater pollution. Thus, soils underlain by bedrock should be sufficiently deep to allow adequate filtering action and destruction of bacteria and pathogens.

Septic tanks located in areas subject to flooding are also a public health hazard and a source of water pollution. In some floodland areas, the systems may function properly during periods of normal stream flow. With flooding, however, the septic tank eventually fills with water; the soil and filter field become saturated; and untreated sewage is carried downstream.

Other factors considered in rating soils for septic tank filter fields include: slope, depth to water table, and soil drainage characteristics.

Degree of limitation:

Slight - Soils having less than 5% slopes; a permeability rate greater than 1.0 in./hr., a percolation rate faster than 45 minutes/ in.; a seasonal water table greater than 4' in depth; well to excessive natural drainage; impervious bedrock, hardpan or permanent water table greater than 6' in depth; no flooding or ponding potential.

(Continued on p. 56-B)

FROM A-2 ON PAGE 56.

Degree of Limitation:

Slight - soils having less than 3% slopes; more than 2,000 lbs. per square inch allowable soil pressure; moderately well to somewhat excessive natural drainage; no flooding or ponding potential; low shrink-swell behavior; no erosion hazard.

Moderate - Soils having from 3 to 10% slopes; between 2,000 to 1,000 lbs. per square inch allowable soil pressure; excessive or somewhat poor natural drainage; a flooding or ponding potential of less than once in one hundred years or subject to sheet flow; slight or moderate erosion hazards; moderate shrink-swell behavior.

Severe - Soils having more than 10% slopes; less than 1,000 lbs. per square inch allowable soil pressure; poor to very poor natural drainage; a flooding potential of once or more in one hundred years; high or very high erosion hazards; severe shrink-swell behavior.

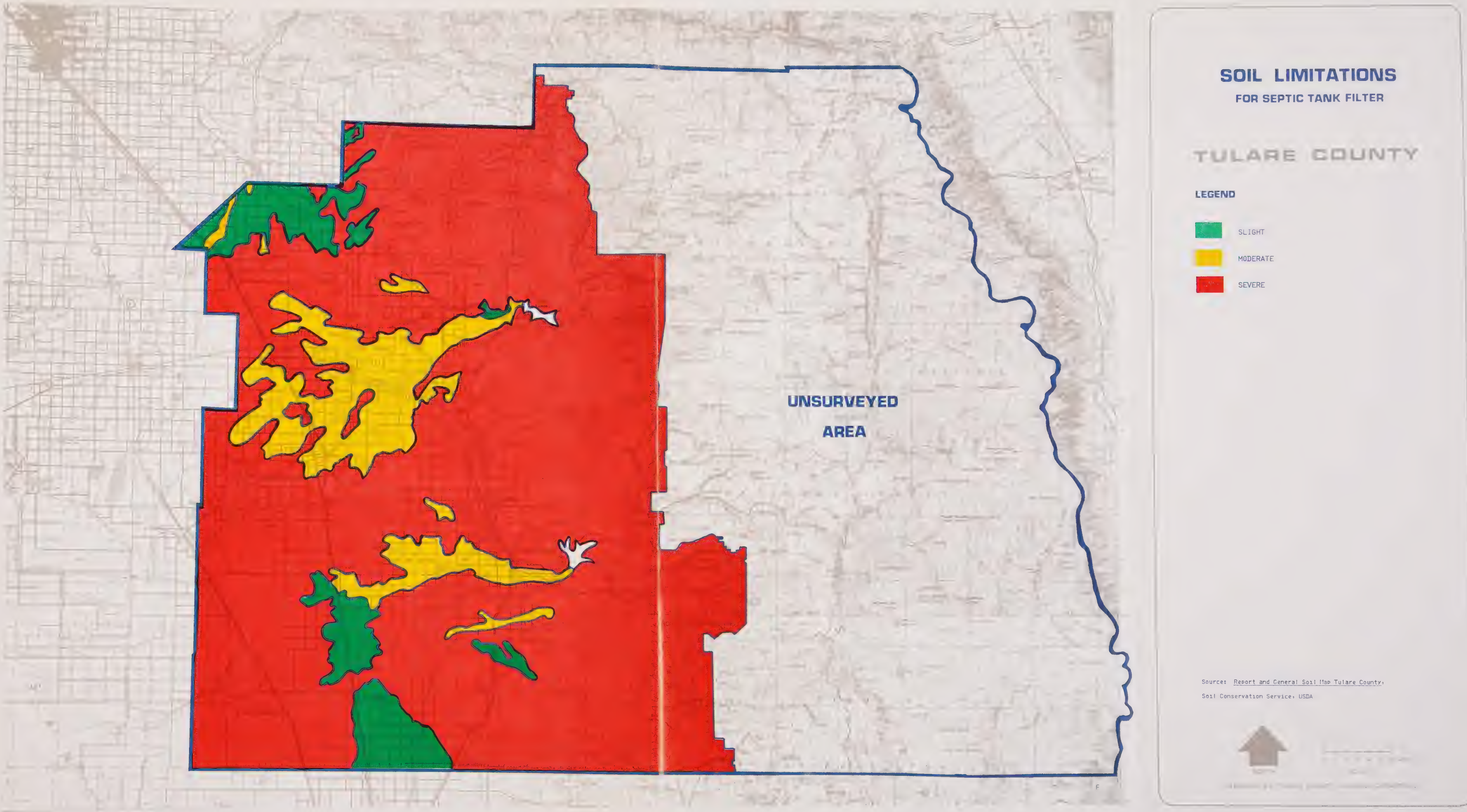
It should be noted that where municipal or community sewers are unavailable, the soil limitation ratings for septic tanks or sewage lagoons should be added to the above classifications. These criteria are found in subsections B-1 and B-2 of this chapter

SOIL LIMITATIONS-SEPTIC TANK FILTER FIELDS

Soil percolation is the single most important soil characteristic considered in determining the limitations for septic tank filter fields. If the effluent is not absorbed rapidly enough it may back up or rise to the surface of the ground. If the effluent drains through the soil too rapidly it may travel unfiltered into groundwater supplies and contaminate them. Other factors considered in rating soils for septic tank filter fields include: slope, depth to water table, soil depth, flood potential, and soil drainage characteristics.

The map illustrates that most of the County area is considered unsuitable for septic tank filter fields (the red areas on the map). The best areas seem to be associated with the major river systems of the County: the Kaweah Delta area, the Kings River-Dinuba area, and a belt of land that extends along the Tule River from Porterville to Tipton and Pixley, and then extends southerly along Highway 65 to Delano.

This map is characteristic of the type of interpretive map that could be used to effectuate overlay zones based upon soil conditions (see Chapter VII). For example, the overlay zone would exclude septic tank filter fields or seepage pits from the unsuitable areas indicated on the map. Any use requiring an on-site sewage disposal system within that area would have to be made a special exception. The text of the zone would specify conditions in which no subsoil sewage disposal units would be allowed and under what conditions special exceptions would be granted. At a minimum the ordinance would specify that on-site soil investigations including percolation tests must be made in all potentially hazardous areas shown on the map. In this way, the Zoning Ordinance becomes a feasible device in dealing with a potential problem in conjunction with existing sanitary code, building code, subdivision ordinance and water quality standards.



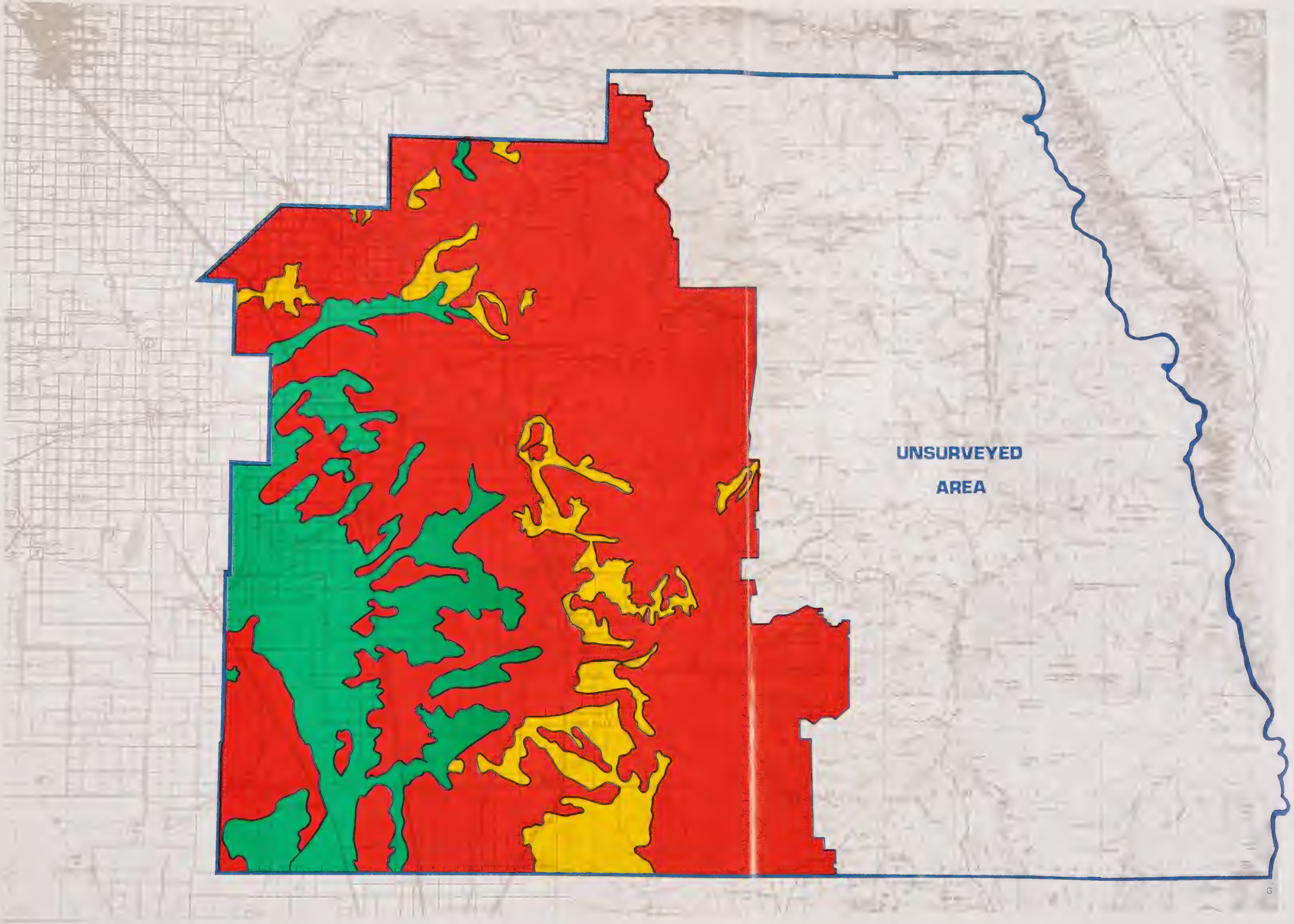
SOIL LIMITATIONS
FOR SEPTIC TANK FILTER
TULARE COUNTY
LEGEND
SLIGHT
MODERATE
SEVERE
UNSURVEYED AREA
Source: Report and General Soil Map Tulare County,
Soil Conservation Service, USDA

SOIL LIMITATIONS FOR SEWAGE LAGOON IMPOUNDMENT AREAS

This map rates the County for development of sewage treatment facilities which involve a sewage lagoon. In general, these ratings are the same for any type of water retention structure including such facilities as irrigation reservoirs, fish ponds, stock water ponds, and recreational lakes. The basic assumption is that when the facility is properly constructed it must be capable of holding water with minimum seepage. The soil requirements are: (1) slow rate of seepage, (2) even surface of low grade in and low relief, and (3) little or no organic matter. It is especially important that the base of the lagoon be nearly impervious so that local water supply from nearby shallow wells may not become contaminated.

The "slight" limitation class includes soils that are effective in functioning as sealed basin floors and that are low in organic matter. Soils in the "moderate" limitation class are those that require special practices or treatment to modify limitations to their use as sites for sewage lagoons. Soils placed in the "severe" limitation class are those that are very porous, or that are high in organic matter, or that have other limitations that prevent their use as sites for sewage lagoons.

This map can be a useful tool in planning for liquid waste treatment facilities. The green areas indicate sites which require a minimum degree of capital improvements necessary to prevent groundwater degradation. The map may also be of use in determining appropriate sites for any type of water retention facility where water storage is the principle function. However, this map should not be used as a guide for locating groundwater recharge facilities.



SOIL LIMITATIONS

FOR SEWAGE LAGOON IMPOUNDMENT

TULARE COUNTY

LEGEND

SOIL LIMITATIONS FOR SEWAGE LAGOON IMPOUNDMENT AREAS

- SLIGHT LIMITATIONS
- MODERATE LIMITATIONS
- SEVERE LIMITATIONS

Source: Report and General Soil Map Tulare County, Soil Conservation Service, USDA

Moderate - Soils having between 5-9% slopes; a permeability rate between 0.63 and 1.0 in./hr.; a percolation rate between 45-75 minutes/in.; a seasonal water table between 2-4' in depth; moderately well to somewhat poor natural drainage; an impervious bedrock, hardpan or permanent water table between 4-6' in depth; a flooding or ponding potential of once or less in ten years providing the duration of the overflow is less than 48 hours.

Severe - Soils having greater than 9% slopes; a permeability rate less than 0.63 in./hr.; a percolation rate slower than 75 minutes/in.; a seasonal water table at less than 2' in depth; poor to very poor natural drainage; impervious bedrock, hardpan or permanent water table at less than 4' in depth; a flooding or ponding potential of more than once in ten years or a potential for any overland flow which would last longer than 48 hours.

B-2 SEWAGE LAGOONS

A sewage lagoon is a shallow lake used to hold sewage for the time necessary for bacterial decomposition. The soil limitation ratings are the same for any type of water retention structure including such facilities as irrigation reservoirs, fish ponds, stockwater ponds and recreational lakes.

Sewage lagoons and water retention structures require consideration of soil for two functions: (1) as a floor for the impoundment area, and (2) as material for the dam. It is normally assumed that the ratings are based upon undisturbed soil and that the permeability rating is based upon the most restrictive layer in the profile. There must be adequate soil material available that is suitable for the structure and, when properly constructed, the lagoon must be capable of holding water with minimum seepage.

Degree of Limitations for the Impoundment Area:

Slight - Soils having moderately slow to very slow permeability, more than 5 feet to bedrock, slopes less than 2 percent and medium to fine soil textures.

Moderate - Soils having moderate and moderately slow permeability, depth of 3 to 5 feet to hard rock, slopes from 2 to 9 percent and moderately coarse to medium soil textures.

Severe - Soils having moderately rapid to very rapid permeability, less than 3 feet to hard rock, slopes more than 9%, and soils that are high in gravels, sands and organic matter.

Degree of Limitation for the Embankment Area:

Slight - Soils having 20 to 50% fines passing a 200 mesh screen and the soil textures are gravelly clay, clay loam and sandy clay loam.

Moderate - Soils having less than 20% fines passing a 200 mesh screen and the soil textures are clay, silty clay, silty clay loam, silt loam, very fine sandy loam, loam and sandy loam.

Severe - Soils having less than 5% fines passing a 200 mesh screen. Soil textures are sandy and gravelly, or a mixture of the two and soils with 15 to 30% organic matter.

B-3 SOLID WASTE DISPOSAL SITES

Solid wastes usually consist of a heterogeneous collection of many materials with an appreciable proportion being water soluble and, hence, available for extraction by water. A wide variety of methods are used to dispose of solid wastes ranging from sanitary landfill projects to open burning pits.

The principal environmental problems relative to solid waste disposal projects concern their effects upon water quality. Basically, solid wastes can be a source of water pollutants by three processes:

(a) The physical removal of waste material directly into surface water sources by flooding or other processes.

(b) Percolation of leachate (see below) into groundwater.

(c) Migration of carbon dioxide (forming dilute carbonic acid) and methane gas from the disposal site into groundwater.

The factors which control these processes are primarily soil or soil-related. These include: texture, permeability, depth to groundwater, rate and direction of groundwater movement, drainage characteristics and flood potential. A buried landfill typically has a high water holding capacity. It readily absorbs water added to it until the materials in the fill become saturated. After the saturation point is reached, a discharge of liquid is produced equal to the amount of additional water infiltrating the fill. This liquid discharge, termed "leachate", may emerge on the surface, move laterally, or pass out of the bottom of the project site.

This saturated condition may be achieved by any one of, or a combination of causes, including:

(a) infiltration of natural precipitation

(b) water applied for compaction, fire control or even irrigation during final use

(c) introduction of surface water

(d) disposal of wastes into ponded surface water or groundwater

(e) rising groundwater levels

(f) lateral infiltration of water from an adjacent source

Biological decomposition of organic materials in a landfill operation produces gas - primarily methane and carbon dioxide. Fortunately, the production of these gases tends to decrease as time goes on. Two environmental conditions affect the rate at which these gases are produced in:

(1) The moisture content in the fill

(2) The climatic characteristics of the area, primarily temperature

Methane is not readily soluble in water; however, it is a combustable gas and presents an ever present possibility of exploding. Carbon dioxide, however, is highly soluble in water and can cause increased hardness (by dissolving minerals) and corrosivity (by producing acid) in water supplies.

The principal water quality problems produced by the contact of water with solid wastes involves three types of conditions:

(1) release of debris materials

(2) changes in the character of water exposed to decomposing wastes

(3) leached organic and inorganic materials

Additionally, differential settling of the fill area during decomposition makes such areas unstable for any construction.

The California Water Quality Control Board (CWQCB) enforces a site rating system, used to determine the types of waste materials that may be safely disposed of in a given site. The purpose of this rating system is the enhancement of water quality. The CWQCB rating system is summarized as follows:

Class 1 Sites - Sites located on nonwaterbearing sediments or with unusable groundwater underlying them; no flooding potential; all internal drainage restricted to the site. Given these specifications, there is no limit on the type of waste materials.

Class 2 Sites- Sites underlain by usable groundwater or located adjacent to streams or other surface water; CWQCB specifies a minimum distance of separation between the bottom of the fill and the surface of the water table. Only decomposable organic wastes, solid waste mixtures containing decomposable material and all materials acceptable at Class 3 sites may be deposited at this type of site.

Class 3 Sites - Sites which intercept groundwater or where wastes are deposited directly into surface water sources. Only non-soluble, non-decomposible, inert solids may be deposited.

Overlying the CWQCB rating system are the soil limitation ratings established by the Soil Conservation Service. In determining the limitations of soils for sanitary landfills, the data provided in a detailed soil survey cannot be substituted for onsite geologic investigations. This is because most soil surveys are limited to the top 5 feet of the soil mantle, whereas sanitary landfills typically extend to depths of 10 to 15 feet. The soil survey, however, can be used to locate promising areas and thereby save the cost of investigating other, potentially hazardous sites.

Generally, there are two types of landfill operations: trench-type and area-type. The trench-type facility is an excavated trench in which wastes are buried daily under a layer of soil material at least 6 inches thick. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the fill. Usually, the soil material used in the daily covering operation is that which was excavated in digging the trench. The final covering material is typically imported. Area disposal facilities compact refuse and fill dirt on the surface of the ground in successive layers. The daily and final cover material is usually imported. When completed, a cover of material at least 2 feet thick is placed over the fill.

Because trenches as deep as 15 feet are used for landfills, geologic investigation is needed to determine the potential for groundwater pollution and to ascertain the design needed. These investigations include examination of stratification, and rock formations that might lead to the conducting of leachates to aquifers, wells, water courses, and other water sources. The presence of hard nonrippable bedrock is undesirable because of difficult excavation problems. Sandy or gravelly strata in or immediately underlying the proposed trench bottom are undesirable from the standpoint of potential pollution of underground water. Tables indicating the degree of limitation used in classifying soils for trench-type and area-type projects are in the appendix.

Much attention is given to type of cover material used in landfill operations. If these soils are to be obtained from a source away from the site, a soil investigation must be made at that site also.

Suitability of a soil for use as cover is based on properties that reflect workability; ease of digging, moving, and spreading over the refuse daily during both wet and dry periods; slope; wetness; and thickness of the soil material. Also, not only must a soil, rated as having slight limitation as a source of cover, have favorable properties but the area from which it is borrowed must be reclaimable. A table illustrating the degree of limitation used in classifying soils for cover material is in the appendix.

The following information defines the significance of the several criteria used to determine soil limitation ratings for sanitary landfills:*

Soil drainage classes and depths to seasonal water table are of primary consideration in interpreting these ratings. The degree of soil wetness and its duration can so affect earth-moving operations as to make a soil severely limiting for the trench-type landfill or for use as cover material for the area-type landfill. Moreover, the probable contamination of groundwater by a landfill is closely related to depth to the seasonal water table.

Permeability of soils is an important consideration in interpreting the limitation ratings for these uses. Soils with slow permeability are most desirable because the probability of polluting groundwater by vertical or lateral seepage is minimized. Permeable horizons near the bottom of the trench-type landfill can be sealed by compacting, along the sides and bottom of the trench, a blanket of relatively impervious material at least 2 feet thick.

Soil slope also is an important consideration in interpreting these limitation ratings. More grading is generally required for the roads that lead to and from landfills located on sloping to steep soils than is required for roads leading to and from landfills on nearly level soils.

Also, more care is needed on sloping to steep soils to provide for the proper disposal of surface water including that from adjacent higher elevations. In a trench-type landfill, the bottom should be kept as nearly level as possible because the bottom tends to serve as a seepage plane; the solid waste layer offers little hindrance to the movement of water. Thus, sloping trench bottoms are likely to bring about difficult seepage problems in completed fills. Trenches should be placed on the contour with bottoms level or nearly so.

Soil texture also is considered in interpreting the limitation ratings of soils for use for landfills and cover material, and especially for trench-type landfill. The ease with which the trench is dug and with which a soil can be used as daily and final cover is based largely on texture and consistence of the soil. From knowledge of texture and consistence of a soil, it is possible to compute the degree of workability of the soil in both dry and wet conditions. Soils that are plastic and sticky when wet are difficult to excavate, grade, or compact. To place a uniformly thick cover of wet clayey soil material over a layer of refuse is extremely difficult.

The uppermost part of the final cover should be soil material that is favorable for the growth of plants. In comparison with other horizons, the A horizon in most soils has the best workability and highest content of organic matter. Thus, in the trench-type landfill operation it is desirable to stockpile the surface layer for use in final blanketing of the fill.

C. CORROSIVITY OF UNDERGROUND CONDUITS OR STRUCTURES

Corrosivity refers to those processes and properties inherent in the soil which corrode structural materials, such as untreated steel pipe, or concrete when buried in the soil. The ratings for soil corrosivity are determined from the physical, chemical and biological characteristics and qualities of the soil. The most important soil characteristics that effect the rate of corrosion of untreated steel are electrical resistance to the flow of current; total acidity; soil drainage; texture of the subsoil; and conductivity of the saturation extract.

It is normally assumed in detailed soil analyses, that the pipe or structure is located in the B horizon of the soil. If the pipe is to be located in other horizons, limitations for these horizons must be considered.

C-1 UNTREATED STEEL PIPE

Steel pipelines placed underground in Tulare County are used mostly to convey water, oil or natural gas. Buried untreated steel pipe corrodes at different rates in different types of soil. The corrosivity is often greatest where the pipe passes from one type of soil to another. This is because the different soil masses have slightly different electrical potentials, due to the relative availability of free ions. The ratings

*Source: Guide to Interpreting the Engineering Use of Soils, USDA Soil Conservation Service, page 36.

for soil corrosivity relate to the physical, chemical, and biological characteristics and qualities of the soils. The most important soil characteristics that affect the rate of corrosion of untreated steel are electrical resistance to the flow of current; total acidity; soil drainage; texture of the subsoil, or of the material at a depth between 10 and 40 inches; and conductivity of the saturation extract. These soil ratings can be combined with other suitability ratings for urban uses (i.e., homes, roads, septic filter fields, etc.) to determine the total capability of the soil to support urban development.

Degree of Limitations:

Low - coarse to medium textured soils having very rapid to moderate permeability; well to excessive natural drainage; a total acidity of less than 8; a conductivity rating of the saturation extract of less than one.

Moderate - Fine and moderately fine textured soils having slow and moderately slow permeability; moderately well drained; a total acidity of between 8 and 12; a rating of 1-4 of the conductivity of the saturation extract.

High - Somewhat poorly drained, fine textured soils, or poorly drained, moderately fine textured soils (including organic soils) having a total acidity greater than 12; a rating greater than 4 of the conductivity of the saturation extract.

C-2 CONCRETE

Concrete materials placed in soil deteriorate to varying degrees. Special cements and methods of manufacturing may be used to reduce the rate of deterioration in soils of high corrosivity. The rate of deterioration is related to (1) the amount of sulfates and (2) soil texture and acidity. Three corrosivity classes are used by the Soil Conservation Service in making soil interpretations. These classes are:

Low - Generally includes (1) coarse-textured and moderately coarse textured soils, organic soils that have pH greater than 6.5 or medium and fine-textured soils that have a pH greater than 6.0, and (2) soils that contain less than 1,000 parts per million of water-soluble sulfate (as S04).

Moderate - Generally includes (1) coarse-textured and moderately coarse textured soils and organic soils that have a pH of 5.5 to 6.5 and medium and fine-textured soils that have a pH of 5.0 to 6.0, and (2) soils that contain 1,000 to 7,000 parts per million of water-soluble sulfate (as SO_4).

High - Generally includes (1) coarse-textured and moderately coarse textured soils and organic soils that have a pH of 5.5 or less, and medium and fine textured soils that have a pH of 5.0 or less, and (2) soils that contain more than 7,000 parts per million of water-soluble sulfate (as SO_4).

D. TRANSPORTATION SYSTEMS AND FACILITIES

Soil interpretations can be highly useful in determining optimum sites for transportation systems and facilities such as roads and highways, railways and airport landing strips. Some of the soil features which affect the location of these facilities are slope and topography, rock outcrops, plasticity, bearing strength, flooding potential, compaction characteristics, shrink-swell behavior, drainage, depth to bedrock and depth to seasonal water table.

D-1 ROADS AND HIGHWAYS

One of the principal applications of soils data in the development of transportation systems is in route location studies. Soil factors are always considered in evaluating or comparing right-of-way acquisition and construction costs of alternative routes. For example, certain subgrade conditions such as shrink-swell behavior and bearing strength give an indication of probable structural and pavement costs. Similarly, a determination of the drainage and permeability characteristics provides one basis for determining drainage costs. Some types of soils such as heavily organic soils which have a low bearing capacity or soils having high flood frequency have severe limitations for any type of transportation use.

In the preliminary evaluation of alternate highway alignments, general soil maps, such as the County General Soils Map following Page 26 are more useful than detailed soil maps. Their utility stems from the fact that generalized soil maps show the location and amount of the different kinds of soil and soil behavior over broad areas. Soil map units also give information directly related to the soil parent materials. These materials usually form the subgrade for highway facilities. Also, soil surveys provide enough information on the depth to shallow rock to make valid preliminary estimates of the costs of rock excavation for an average depth of the rock cut. Since the cost of rock excavation is usually three to four times that of common earth excavation, the cost of an alignment over shallow rock might easily be 50 to 100% greater than one where only earth excavation was required.

Similarly, topography and erosion hazards are important considerations in route determination, especially where soils subject to mass movement have been identified. Knowledge of the position of the water table during the spring of the year (usually, the seasonal high) can prevent much wasted time and effort during the construction phase of road building. If a high water table is present, heavy construction equipment cannot operate efficiently.

There are many other examples which show how soil maps and their interpretations can help to delineate or forecast construction problems. Modern detailed soil surveys prepared by the Soil Conservation Service often contain extensive engineering tests and interpretations of soils which can be of significant use in determining optimum route locations. The limitation ratings described below apply to use of soil for construction and maintenance of improved local roads and streets that have all-weather surfaces - commonly asphalt and concrete. Excluded from consideration in the ratings are highways designed for fast-moving, heavy trucks. It should be noted that these ratings cannot substitute for basic soil data and for onsite investigation.

Degree of Limitation:

Slight - Soils having less than 9% slopes; sandy loam, loamy sand, loam or very gravelly textures; a soil depth of more than 48"; less than 3% stoniness and less than 2% rockiness; a seasonal high water table at more than 5' in depth. Soils classified as GW, GP, GM, GC, SW, SP & SM under the Unified system are included in this category.

Moderate - Soils having from 10% to 15% slopes; silt loam, clay loam, silty clay loam, sandy clay loam or all gravelly texture; a soil depth of from 24 to 48"; from 3 to 15% stoniness; from 2 to 10% rockiness; a seasonal high water table from 3 to 5' in depth. Soils classified as ML, CL, GM, GC or SC under the Unified system are also included within this category.

Severe - Soils having more than 15% slopes; sand, clay, silty clay, or silt textures and all organic soils; a soil depth of less than 24"; more then 15% stoniness or more than 10% rockiness; a seasonal high water table at less than 3' in depth. Soils classified as MH, CL, OR, CH, OL, OH, or Pt under the Unified system are also included in this category.

It should be noted that related soil suitability ratings used for determining road fill can be found under "Construction Materials" beginning on page 64.

E. RECREATION DEVELOPMENT

In general, nearly all soils in the Tulare County area have potential for one or more kinds of recreational use. All of the soils in the area can be rated according to their suitability for campgrounds and picnic areas; and for playgrounds and athletic fields. Playgrounds, and athletic fields are mostly used on a year-round basis, and campgrounds and picnic areas are usually used seasonally. Rating for golf courses and for other forms of recreation having grass or turf requirements are found under "landscaping". Limitations for ponds, lakes and reservoirs used for recreation are found under soil ratings for "sewage lagoons" on page 57.

The main soil characteristics that determine the suitability of a soil for recreational development are the number of stones and rocks in and on the soil; texture of the surface layer; permeability of the subsoil; erosion hazard; drainage; depth to the seasonal high water table; and the hazards of flooding and ponding. A soil characteristic may apply specifically to one recreational use, to two uses, or to all three uses, and may vary in limitation rating, depending upon the use or combination.

These soil ratings for recreational uses do not consider such features as location, accessibility, kind of vegetation, water supply, and other practical or esthetic features of a given site. However, an evaluation of these features made at the site, considered along with soil limitation ratings, provides a means for determining the capabilities of a site for a specific type of recreation.

E-1 PLAY AREAS (Intensive Use)

Play areas are grounds planned for organized games such as baseball, football, badminton, volleyball and similar recreational activities. In rating the soils, it is assumed that intensive foot traffic is involved and a nearly level, firm surface and good drainage will be generally needed. Rock outcrops and coarse fragments are also not desirable. It is assumed that good vegetative cover can be established and maintained.

Because this type of recreational use requires a nearly level surface, any variation in topography would necessitate land leveling. Texture of the surface layer is investigated because of the need for smooth, firm surfaces which can withstand intensive foot traffic. The surface content of gravel, stones, cobbles or rock outcrops is important for the same reason. Soil drainage, permeability, flood potential, depth to water table and bedrock or hardpan are rated according to their limitations in dispersing precipitation and surface runoff.

Degree of Limitations:

Slight - Soils having less than 3% slopes; textures ranging from loams to fine and very fine sandy loam; no rock outcrops; no stone, gravel, or cobble content on the surface; hard rock, hardpan or seasonal water table more than 40" in depth; no overflow hazard; moderate to rapid permeability; moderately good to somewhat excessive natural drainage.

Moderate - Soils having between 3 and 5% slopes; loamy sands, silty loams, clay loams, silty clay loams and sand clay loam textures; less than 5% gravel content; stones, cobbles and rocks covering less than 3% of the surface; hardrock, hardpan, or seasonal water table between 20-40" in depth; a flood potential of once or twice in ten years; excessive or somewhat poor natural drainage; very rapid or moderately slow permeability.

Severe - Soils having more than 5% slopes; sand, sandy clay, silty clay, or clay textures; all organic soils; more than 5% gravel content; stones, cobbles and rocks covering more than 3% of the surface; hardrock, hardpan or seasonal water table less than 20" in depth; poor or very poor natural drainage; slow or very slow permeability; a flooding potential of more than twice in ten years.

E-2 PICNIC AREAS (Intensive Use)

Picnic areas are places where people eat meals outdoors. At these areas people can be close to nature and enjoy the quiet seclusion of country life. Picnic areas normally do not involve active recreation and heavy foot traffic. Thus the soil features which are considered as limiting for planning picnic areas are not as extensive as those considered for active recreational development. Problems of sewage disposal and water supply usually are not considered in the soil rating.

Topographical restraints are not nearly so limiting since less site preparation of land leveling is required. The texture of the surface layer is interpreted only in terms of limitations because of dust. Because it is assumed that picnic areas will be used intensively only during the warm months of the year, the ability of the soils to drain precipitation and runoff are not considered as major limiting factors. Soil suitability for maintaining shade trees is desirable.

Degree of Limitations:

Slight - Soils having less than 6% slopes; a wide range of texture including loams, sandy loams and gravelly loams; stones, cobbles and rocks covering less than 3% of the surface; a seasonal water table more than 40" in depth; a nondamaging flooding potential of less than once in ten years; moderately good to somewhat excessive natural drainage.

Moderate - Soils having between 6 and 15% slopes; a wide range of textures including loamy sands, clay loams, gravelly clay loams and gravelly silty loams; stones, cobbles and rocks covering between 3-15% of the surface; a seasonal water table between 20" - 40" in depth; a nondamaging flood potential of once or twice in ten years; excessive or somewhat poor natural drainage.

Severe - Soils having more than 15% slopes; very fine textures such as clay or silty clay, and very coarse textures such as gravelly sand or very gravelly soils; all organic soils; stones, cobbles and rocks covering more than 15% of the surface; a seasonal water table of less than 20"; a nondamaging flood potential of more than twice in ten years, or any potential for damaging flooding; poor or very poor natural drainage.

E-3 CAMPSITES (Intensive Use)

Campsites are used intensively for tent, camper, motorhome, and small travel trailer sites and the accompanying activities of outdoor living. The preferable sites require little site preparation other than shaping and leveling camp sites and parking areas. The area should be suitable for heavy traffic by humans, horses, and vehicles. In rating the soils it is assumed that the suitability of the soil for supporting vegetation is a separate item to be considered in the final evaluation of the site. Problems of sewage disposal, water supply and access roads **are not considered in the soil rating.**

Soil limitations which are considered for campsite development are very similar to those considered for picnic areas. Topography is slightly more restraining due to the need for more site preparation. The major difference, however, is the soil interpretation for drainage, permeability and flood potential. These factors are of considerable importance because people will be staying overnight in these areas.

Degree of Limitations:

Slight - Soils having less than 5% slopes; loam, sandy loam and fine sandy loam textures; stones, cobbles and rocks covering less than 3% of the surface; no flooding potential, a seasonal water table at more than 40" in depth; moderately good to somewhat excessive natural drainage; moderate to rapid permeability.

Moderate - Soils having between 5-9% slopes; textures ranging from clay loams and very fine sandy loams to gravelly loams and gravelly clay loams; stones, cobbles and rocks covering 3-10% of the surface; a flood potential of less than once in ten years; a seasonal water table between 20-40" in depth; excessive or somewhat poor natural drainage; moderately slow or very rapid permeability.

Severe - Soils having more than 9% slopes; textures ranging from clay and silty clay to sand, sandy clay and all very gravelly soils; all organic soils; stones, cobbles and rocks covering more than 10% of the surface; a flood potential of one or more for every ten years; a seasonal water table at less than 20" in depth; poor to very poor natural drainage; slow or very slow permeability.

E-4 PATHS AND TRAILS

These areas are rated for locating trails, cross-country hiking and bridle paths where people are moving at random. It should be noted that this rating does not apply to trails for cross-country motorcycles or four-wheel drive vehicles.

In rating the soils for paths and trails, an assumption is made that the soils are to be used as they occur naturally and that little disturbance or modification will be required. Ratings are based on soil properties and qualities only and do not include other features that may be important in site selection. Soils rated as severe, may be best from an aesthetic standpoint, but their use requires more preparation and maintenance (for example, a mountain lookout requiring a guard-rail).

Degree of Limitations:

Slight - Soils having less than 15% slopes; all textures except those having severe limitations; stones, cobbles, and rocks covering less than 3% of the surface; no flooding or ponding potential; moderately good to excessive natural drainage; a seasonal water table greater than 40" in depth.

Moderate - Soils having between 15-30% slopes; stones, cobbles and rocks covering 3 to 10% of the surface; a flooding potential of less than twice in ten years; excessive or somewhat poor natural drainage; a seasonal water table at 20 to 40" in depth.

Severe - Soils having more than 30% slopes; coarse textures such as sand, gravelly sand and all very gravelly textures; all organic soils, stones, cobbles and rocks covering more than 15% of the surface; a flooding or ponding potential of more than once in ten years; poor and very poor natural drainage; a seasonal water table at less than 20" in depth.

E-5 LANDSCAPING (Lawns and Golf Fairways)

These areas are used for lawns in residential areas and areas of open space around factories, apartments, schools, and in intensively used parks and for golf fairways. In rating the soils for lawns and golf fairways, it was assumed that this rating would not apply to sites that have been leveled or where the topsoil is to be imported fill. Also, the rating does not apply to traps, roughs and greens as a part of the golf fairway. Vegetative species is not considered as a part of the rating although natural vegetation may help initially locate generally appropriate soils.

The rating of soil factors is based primarily on the projected use of the soils for growing vegetation. Surface textures and rockiness of the surface are also important in golf course development due to the intensive nature of the sport.

Degree of Limitations:

Slight - Soils having less than 3% slopes; sandy loam, fine and very fine sandy loam, loam and silty loam textures; no stones, cobbles and rocks on the surface; hardrock, hardpan and seasonal water table at more than 40" in depth; moderately good and good natural drainage; no flooding or ponding potential; moderate to moderately rapid subsoil permeability; more than 5" total available water holding capacity (AWHC) averaging more than 1.5"; a conductivity rating of less than 4; less than 15% exchangeable sodium in the upper 20" of the soil.

Moderate - Soils having between 3-15% slopes; textures ranging from clays and clay loams to gravelly clays, loams and silts; stones, cobbles and rocks covering less than 3% of the surface; hardrock, hardpan and seasonal water table at 20-40" in depth; somewhat excessive or somewhat poor natural drainage; a flood potential of less than once in ten years; rapid or moderately slow subsoil permeability; between 5-3.75" total AWHC averaging 1.0-1.5"; a conductivity rating of 4-8.

Severe - Soils having more than 15% slopes; sandy and all very gravelly textured soils; all organic soils; stones, cobbles and rocks covering more than 3% of the surface area, hardrock, hardpan and seasonal water table at less than 20" depth; excessive or poor to very poor drainage; a flood potential of once or more for every ten years; very rapid to slow to very slow subsoil permeability; less than 3.75" total AWHC averaging less than 1.0"; a conductivity rating of more than 8; more than 15% exchangeable sodium in the upper 20" of the soil.

F. SAND AND GRAVEL EXTRACTION

One of the values of a detailed soil survey is that it can help to locate sources of construction materials such as sand and gravel. These materials are essential to the economy of the County because they are basic to the construction industry.

The location of these materials is the most important factor associated with the recovery of these resources. Obviously, deposits must be developed where they are found. However, since these deposits are often found in areas more suitable for other use (e.g., residential, recreation or industrial development), land conflicts are bound to occur. Such conflicts result because of the objectionable characteristics often associated with the extraction, processing and transportation of the material. Objectionable characteristics may include noise, vibration, dust, air pollution, stream impairment, traffic, unsightly appearance, and health and safety factors. These objectionable factors are now mitigated by most modern extractors in order to avoid or minimize conflicts.

Most sand and gravel areas are located in the flood plains of existing rivers and streams or in the stream beds of ancient water courses. Although most of these areas are already in agriculture or open space use, there is an ever increasing demand for river frontage recreational or residential development.

Significant problems arise when the land lying above the deposits is developed to urban use. When this occurs, the resource is essentially lost to the industry. It is to this extent that proper land use planning should encourage staging development to occur after the resource has been extracted.

The criteria used to evaluate the suitability of deposits of construction material appears in the following sections.

F-1 SOURCE OF SAND

Soils are classified as a source of construction material for use in making cement, plaster and mortar. When making the ratings, accessibility and depth to water table are not considered. Similarly, gradation and mineral quality of the sand are not considered. In precise soil surveys undertaken by the Soil Conservation Service, each major or distinct horizon in the profile is evaluated separately.

Degree of Suitability:

Good - Soils having less than 10% fines passing a 200 mesh screen; a thickness of material of more than 5'; sand texture (USDA) or classified as SW, SP, GP or GW under the Unified System; a depth of overburden of less than 20".

Fair - Soils having 10 to 20% fines passing a 200 mesh screen; a thickness of material of 3 to 5'; loamy sand texture (USDA) or classified SM under the Unified System; 20 to 40" of overburden.

Poor - Soils having 20 to 50% fines passing a 200 mesh screen; a thickness of material of 1 to 3'; sandy loam texture or classified SC under the Unified System; 40 to 60" of overburden.

Unsuitable - Soils having more than 50% fines passing a 200 mesh screen; a thickness of material of less than one foot; loam, silt loam, clay loam or clay texture (USDA) or classified as CL, ML, MH, CH, OH, GM, GC, OL or Pt under the Unified System; more than 60" of overburden.

F-2 SOURCE OF GRAVEL

It is normally assumed that soils are classified as a source of material for use in concrete aggregate. The particle size of gravel ranges from 1/4 to 3" in diameter. When making the ratings, accessibility and depth to groundwater are not considered. Similarly, gradation and the quality of the gravel are not considered. Each major or distinct horizon in the profile is rated separately.

Degree of Suitability:

Good - Soils having more than 75% gravel content, less than 20" of overburden with the layer of material more than 5' thick.

Fair - Soils having 50 to 75% gravel content, from 20 to 40" of overburden, with the layer of material from 3 to 5' thick.

Poor - Soils having 25 to 50% gravel content, 40 to 60" of overburden, with the layer of material from 1 to 3' thick.

Unsuitable - Soils having less than 25% gravel content, more than 60" of overburden, with the layer of material less then one foot in thickness.

F-3 SOURCE OF ROAD FILL

Soil analysis for road and highway locations generally include an evaluation of soil suitability as a source of road fill along a given route. Each soil encountered is classified according to its performance when excavated and used as fill for road subgrade.

The characteristics of the soil, to a large degree, determine the type of design needed. Some soils such as gravelly loam or sandy loam may be suitable with only a minimum amount of blending and compaction to meet standards. Peaty or mucky soils, or highly plastic clays are not suitable and would result in a "washboard" effect on road surfaces if used for subgrade material.

Soils can be rated using each of three soil classification systems, the USDA texture classification system, the AASHO classification system, and the Unified Soil Classification System. The degree of limitations used to rate soils to meet subgrade standards are indicated in the following table:

TABLE NO. 5

SOIL SUITABILITY AS A SOURCE OF ROAD FILL

Suitability Rating	USDA Texture	AASHO	Unified
Good	gravel*	A-1-a	GW or GP
	silty gravel*	A-1-a, A-2-4 or -5	GM
	clayey gravel*	A-2-6 or -7	GC
	sand	A-1-b, A-3	SW or SP
	loamy sand, sandy loam, sandy clay loam, sandy clay	A-1-b, A-2-4 A-2-6 or -7, A-4 A-6, A-7-6	SM-1 or 2, SC
Fair	silt, silt loam, sandy loam, loam	A-4	ML
	silt loam, loam, sandy loam	A-4, A-6	ML-CL
	silt loam, loam, silty clay loam, clay loam, sandy loam, sandy clay loam	A-4, A-6, A-7-6	CL
Poor	silty clay, clay, sandy clay	A-7-5, A-7-6	MH, CL or CH
	organic silt* or clay	A-4, A-7-5	OL
	organic clay*	A-7	OH
	peat	A-8	Pt

*Not USDA Soil Texture; noted for explanatory purposes.

References:

(1) United States Department of Agriculture. 1967. Guide for Interpreting Engineering Uses of Soils (for interim use). Soil Conservation Service.

(2) Portland Cement Association. 1962. P.C.A. soil primer.

(3) United States Department of Army. Technical manual TM-5541.

F-4 SOURCE OF TOPSOIL

Topsoil is frequently needed to establish a vegetative cover for erosion control on sloping areas, the banks of waterways, road cuts or housing projects where extensive site preparation is necessary. It is also used to help induce the growth of vegetation for lawns and golf courses, and may be needed to secure the surfaces of landfill solid waste disposal sites. The soil is rated on the basis of the characteristics and thickness of the surface soil, difficulty of obtaining the material, and the presence of gravel and cobbles. However important to the final decision, accessibility and the existence of weeds, soil-borne diseases and insects are not considered in the ratings. As in soil suitability analysis for construction material, each major or distinct horizon in the profile is evaluated separately for topsoil sources.

Degree of Suitability:

Good - Soils having less than 2% slopes; loam, silt loam or fine silt loam textures; less than 15% gravel content; a pH of 6.1 to 7.3; a high to very high inherent fertility rating; a topsoil thickness of more than 40"; good natural drainage; a conductivity of the saturation extract of less than 2.

Fair - Soils having from 2 to 15% slopes; silty clay loam, sandy clay loam, clay loam or sandy loam texture; from 15 to 50% gravel content; less than 15% cobble content; a pH of 5.1 - 6.0 or 7.4 - 7.8; a moderate inherent fertility rating; a topsoil thickness of from 20 to 40"; somewhat excessive or moderately good drainage; a conductivity of the saturation extract of 2 - 4.

Poor - Soils having greater than 15% slopes; clay, loamy sand or sand textures; more than 50% gravel content; more than 15% cobble content; a pH of less then 5.0 or more than 7.9; a low or very low inherent fertility rating; a topsoil thickness of less than 20"; excessive or somewhat poor to very poor natural drainage; a conductivity of the saturation extract of more than 4.

G. INTERPRETATIONS FOR AGRICULTURAL USE

Five types of soil interpretations are used nationally to evaluate soil capability for agriculture and forestry. These include: Land Capability Classification, Storie Index Rating, Range Site Groupings, Vegetative Groupings and Woodland Suitability Groupings. The 1967 General Soils Survey of Tulare County contained interpretations and ratings by soil association for most of these classification systems (with the exception of the Storie Index Ratings). The following sections describe, in general, how these interpretations are made, and provide a brief analysis of the classification system used in each system.

G-1 LAND CAPABILITY CLASSIFICATION

Capability groupings are intended to show the suitability of soils for most types of cultivated crops and pasture without soil deterioration over a long period of time. The groupings are made according to the limitations of soils when used for most types of cultivated crops, the risk of damage when they are used, and the way they respond to treatment. The classification system is a systematic arrangement of soils according to those properties that determine their ability to produce.

There are eight broad capability classes under this system which are briefly defined as follows:

Land Suited for Cultivation

Class I - Very good cultivatable land - soils have few limitations that restrict their use.

Class II - Good cultivatable land with minor limitations that reduce the choice of plants or require moderate conservation practices.

Class III - Moderately good cultivatable land with severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV - Fairly good land suited only for limited or occasional cultivation - these soils have very severe limitations that reduce the choice of plants, require very careful management or both.

Land Not Suited for Cultivation

Class V - Very well suited for grazing or forestry - these soils have limitations for cultivation that are impractical to remove - these soils have few erosional problems.

Class VI - Well suited for grazing or forestry - these soils have severe limitations that make them unsuitable for cultivation.

Class VII - Fairly well suited for grazing or forestry with major limitations in use - these soils also have severe limitations that make them unsuitable for cultivation.

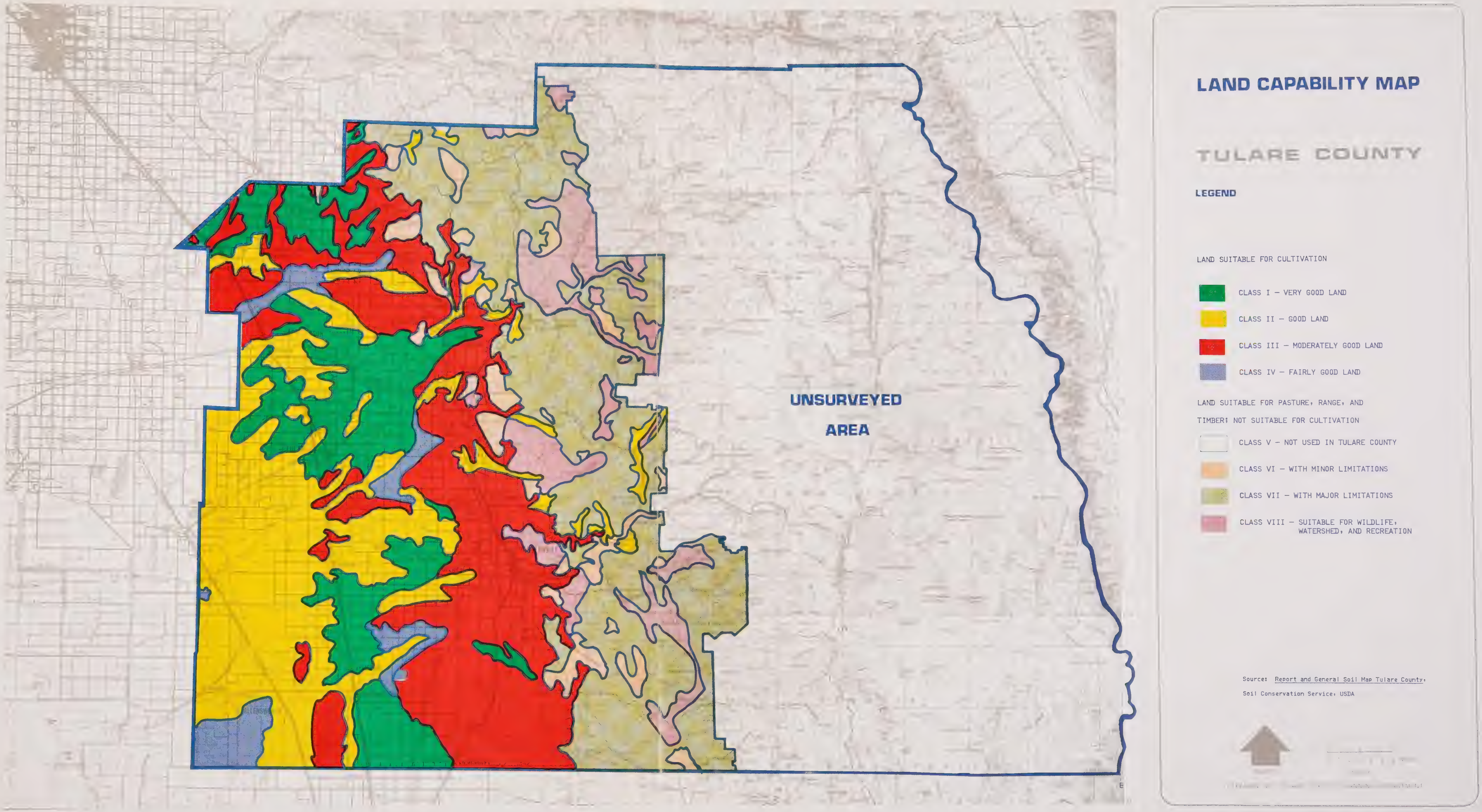
Class VIII - Land not suited for cultivation, grazing or forestry. It may be used for wildlife, recreation, protection of water supplies or esthetic purposes.

LAND CAPABILITY MAP

The land capability groupings on the map are intended to show the suitability of soils for most types of cultivated crops and pasture without soil deterioration over a long period of time. In general, Class I, II and III comprise the most important agricultural soils in the County. These are located primarily in the central valley where a long growing season together with the availability of irrigation water makes this area one of the most important crop producing regions of the nation. The Class I designation signifies that the land is suitable for sustained high yields of most climatically adapted crops with minimum costs of development and management. Class I is thus considered the best agricultural land. Class II and III lands are also characterized by high yields but are more restricted due to conditions such as existence of hardpan layers, fine textured soils, or low water holding capacity.

Class IV soils are also considered arable, but contain severe limitations in one or more land characteristics, such as high concentrations of salts and alkali. These adverse soil conditions limit the use of Class IV areas to pasture and grain production.

Class I-IV soils comprise the great majority of the valley area of the County. Only isolated topographic features such as Venice Hills, which extend into the valley, are considered inappropriate for cultivation. In general, the foothill and mountainous portions of the County contain lands which are suitable for pasture, range and timber production. These areas are illustrated by Class VI, VII, and VIII areas on the map. Class VI and VII areas are considered suitable for grazing or forestry while Class VIII lands are best used for wildlife, recreation, protection of water supplies or aesthetic purposes.



LAND CAPABILITY MAP
TULARE COUNTY
LEGEND
LAND SUITABLE FOR CULTIVATION
CLASS I — VERY GOOD LAND
CLASS II — GOOD LAND
CLASS III — MODERATELY GOOD LAND
CLASS IV — FAIRLY GOOD LAND
LAND SUITABLE FOR PASTURE, RANGE, AND TIMBER; NOT SUITABLE FOR CULTIVATION
CLASS V — NOT USED IN TULARE COUNTY
CLASS VI — WITH MINOR LIMITATIONS
CLASS VII — WITH MAJOR LIMITATIONS
CLASS VIII — SUITABLE FOR WILDLIFE, WATERSHED, AND RECREATION
UNSURVEYED AREA
Source: Report and General Soil Map Tulare County, Soil Conservation Service, USDA

The picture in the upper left indicates both the erosional and depositional effects of water on land where natural vegetation has been removed and where soils are not capable of maintaining their stability under relatively mild rainfall or irrigation flows. Some of this effect shown in the upper left photo was caused merely by sprinkler water runoff. Mulching is recommended on such slopes with this kind of soil.

The upper right photograph and the two lower pictures show some of the effects where man has attempted to counteract the natural erosional processes which he has accelerated by making modifications in the landscape and the soils. The erosive force of the water is clearly shown. The lower right picture especially illustrates the effects which occur when man ignores the natural drainage pattern of an area. Such effects could have been averted had he taken the time to provide for a flood channel through this area. Soil surveys can indicate how rapidly soils can absorb water upstream from such facilities and thus help in planning downstream flood control projects.

Source: USDA Soil Conservation Service

Here the deposited soil from an erosional system is blanketing the roots of these trees and has completely blocked a drop inlet in the local drainage system. The two bottom photographs show the effects of erosion on lands from which the ground cover has been removed. Soils information provided to agricultural persons in advance of such damaging actions may have encouraged the land user to protect the soil with various devices or vegetation in order to help to prevent this kind of soil damage. This latter kind of erosion is termed "rill" erosion and typically occurs on more steeply sloping topography. Soil losses are estimated at 25 tons per acre in the lower left photograph during one rainfall. The lower right photograph illustrates rill erosion occurring on a 12 percent slope with an estimated loss of 32.5 tons per acre.

Conservation practices such as mulching, terracing, contour farming or the development of a natural cover crop could have helped to avoid the loss.

Source: USDA Soil Conservation Service

A further breakdown of the Land Capability Classification involves the use of capability subclasses. These are designated by adding a small letter e, w, s, or c to the class numeral, for example, IIIw. These four subclasses are briefly defined as follows:

e - Land limited in use by erosion or slope or both - requires use of close growing plant cover

w - Land limited in use by excessive water in the soil, or by flooding in some soils the wetness can be corrected by artificial drainage

s - Land limited in use by unfavorable soil conditions such as shallowness, clayey coarse texture, alkalinity or salinity

c - Land limited in use by adverse climatic conditions, such as very low rainfall where water for irrigation is not expected in the foreseeable future - this classification is not used in areas surveyed in Tulare County

In Class I there are no subclasses because by definition Class I land has few limitations. Similarly, Class V land can contain only subclasses w, s and c because by definition erosion (e) is not a problem. When a single piece of land is affected by more than one of the four kinds of limitations only the dominant one is indicated.

A further segregation of land limitations can also be defined within the capability subclasses. These are termed capability units in which the soils are enough alike to be suited to the same crops and pasture plants, to require similar management and to have similar productivity and other responses to management. An arabic numeral is used to designate capability units. These are defined as follows:

0. A problem or limitation caused by sand or gravel in the substratum.

1. A problem or limitation caused by slope, or by actual or potential erosion hazard.

2. A problem or limitation of wetness caused by poor drainage or flooding.

3. A problem or limitation of slow or very slow permeability of the subsoil, or substratum that is semi-consolidated.

4. A problem or limitation caused by low available moisture capacity (coarse textures).

5. A problem or limitation caused by fine textured surface soil.

6. A problem or limitation caused by excessive salt or alkali.

7. A problem or limitation caused by rocks, stones, or cobblestones.

8. A problem or limitation caused by shallow depth of soil to hard bedrock or an indurated layer (hardpan).

9. A problem or limitation caused by low fertility or toxic elements in the soil.

10. A problem or limitation caused by highly organic soils (peat).

Capability units which end in two numbers contain soils that have limitations or problems of a dual nature. The capability units which were defined for Tulare County under the 1967 General Soils Survey are included in the Appendix of this document.

The map preceding this page indicates the assigned land capability ratings for the area inventoried under the 1967 General Soils Study. No Class V land is indicated on the map because these areas are not extensive enough to be mapped at this scale.

One of the principle problems found to exist with the land capability classification is that the soils are evaluated as they would have existed in a natural, or pre-cultivated state. Thus, most of the prime citrus growing acreage in the County is rated as Class IIIs-8 because under natural conditions, these soils were underlain with hardpans. In point of fact, most of the original hardpan layer in these soils have been removed in order to allow intensive cultivation. Removal of the hardpan layer converts the land into the Class II category. However, because of the highly generalized nature of the 1967 Soil Survey, this fact could not be considered and these soils were uniformly classified as Class III, regardless of reclamation measures which may have taken place.

G-2 STORIE INDEX RATING

This rating system expresses numerically the relative degree of suitability, or value, of a soil for general intensive agriculture. Thus, this system is roughly comparable to the Land Capability Classification. The basic difference is that the Storie index does not account for suitability for pasture, rangeland, forestry or uses other than intensive agriculture. Because it provides another method of determining the potential productivity of a given soil, its principle value is as a supplement to the Land Capability Classification.

The rating is based solely upon evaluation of soil characteristics, such as, depth, texture, subsoil density, drainage, salinity/alkalinity and topography. Other mitigating factors such as availability of water, climate, etc....are not considered in the rating system.

Four general factors are considered separately in rating soils under the Storie System. These factors are:

(A) The characteristics of the soil profile, particularly permeability and depth

(B) The texture of the surface soil

(C) Slope

(X) Other factors or limitations, e.g., nutrient level, flooding, drainage, salinity/alkalinity, erosion and micro-relief

Each of these factors is rated on the basis of 100% in which a designation of 100 expresses the most favorable, or ideal conditions. Lower ratings result when less than favorable conditions for crop production are found to exist. A final index rating is determined by multiplying all 4 factors (A, B, C & X). Thus, under this procedure, any less-than-favorable factor may control the rating. For example, a soil with the following factor ratings: A-100; B-100; C-100; X-10 would have a final Storie index rating of 10. Thus the final factor would dominate in determining the quality or suitability of the soil for agriculture. Similarly, if each of the factors was rated as 95 the final Storie rating would be 82 (.95 x .95 x .95 x .95 = .82).

The Storie index ratings for soils surveyed and identified in the Visalia Area Soil Survey and Pixley Area Soil Survey are included in the appendix.

G-3 INTERPRETATIONS FOR VEGETATIVE SOIL GROUP

Vegetative soil groups are capability units which have similar plant adaptations or limitations. They are used primarily for determining the best adapted plants for conservation practices such as erosion control, and for open space, recreation or landscaping around industrial, commercial and residential development. The groupings also may be used to estimate forage production for pasture lands.

Each capability unit contains soils having similar major soil features that affect or influence the growth of vegetation. Other environmental factors such as climate are usually considered separately.

The 1967 General Soils Survey identified six vegetative groupings in the County. These are described as follows:

Group A - Suitable for all climatically adapted plants. Soils are deep to very deep, moderately well to well drained, with moderately rapid to moderately slow permeability.

Group B - Choice of plants limited by drouthiness and low fertility. Soils are coarse to gravelly, medium textured, excessively drained, with less than 5 inches of available water-holding capacity.

Group C - Choice of plants limited by fine textures. Soils are deep to very deep, moderately fine to fine textured, moderately well to well drained, with moderately slow to slow permeability.

Group F - Choice of plants limited by salinity or alkalinity. Soils are moderately to strongly saline alkali, and moderately well to poorly drained.

Group G - Choice of plants limited by depth. Soils are shallow to moderately deep, moderately well to somewhat excessively drained, over hardpan, bedrock or other nonfractured dense material.

Group J - Choice of plants depends upon on-site investigations. Soils include those in the miscellaneous nonarable category, such as riverwash and stony or rocky uplands.

The location of these capability units are indicated on a map following page 70.

G-4 RANGE SITES

The determination of range sites is based upon soils which produce essentially the same kind and amount of forage. The inherent productive capacity of different kinds of rangeland depends upon the combined affects of soils and other environmental factors such as climate. The concept of "range sites" is used to express the differences from place to place. The identification of different range sites also provides an inventory of forage potential of grazing land and form a basis for proper management.

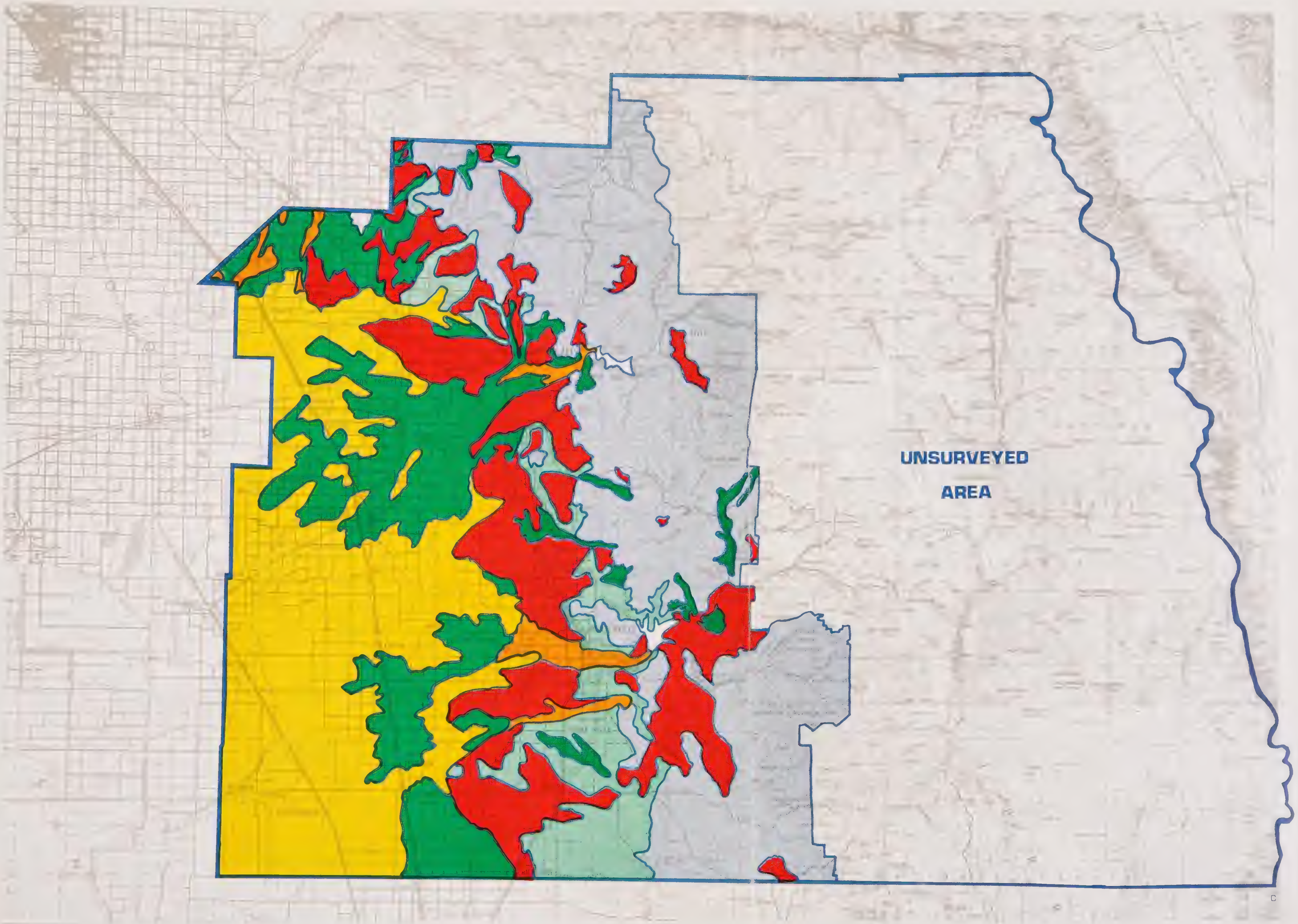
The 1967 General Soils Survey identified two mapping units for range sites in the County. These two range sites are generally described as follows:

VEGETATIVE SOIL GROUPS

Vegetative soil groups consist of soils having about the same major soil features. They are primarily used for determining the best adapted plans for conservation practices (e.g., erosion control), open space landscaping around factories, apartment houses, school buildings, and intensively used parks, or for the production of forage.

The map shows that there are six vegetative soil groups identified in Tulare County. Each group is determined by the major soil feature which determines plant adaptation and permissible range. The primary limiting soil feature for each group is indicated on the map legend.

The Group A soils are suitable for all climatically adopted plants and are similar in extent to the Class I soils indicated on the Land Capability Map. The choice of plants in Group B soils is limited by droughtiness and low fertility caused by excessively drained, coarse textured soils. These soils are typical of floodplain areas where deposits of sandy soils and alluvium are found. Group C soils are characterized by fine textured soils (e.g., Porterville clay), where permeability is very slow and water-holding capacity is high. The best choice of plants in Group C areas would be those that are adaptable to fine textures. Group F soils are characterized by salinity or alkalinity, which is found in the westerly portion of the County. Under natural conditions this area would be suitable only to those types of plants which tolerate great amounts of salts or alkali. In Group G the choice of plants is limited by shallow depths. This group includes the belt of hardpan soils which exists along the base of the foothills. The final group, Group J, includes the wide range of soil types found in the foothills and mountainous areas of the County. The choice of plants in this area depends upon detailed on-site investigations.



VEGETATIVE SOIL GROUPS

TULARE COUNTY

LEGEND

PRIMARY LIMITING SOIL FEATURE

- GROUP A – NONE
- GROUP B – COARSE TEXTURES
- GROUP C – FINE TEXTURES
- GROUP F – SALINITY OR ALKALINITY
- GROUP G – SHALLOW DEPTHS
- GROUP J – MISCELLANEOUS

Source: Report and General Soil Map Tulare County, Soil Conservation Service, USDA

RANGE SITES AND WOODLAND GROUPINGS

Range Sites and Woodland Groupings are a further refinement of the land capability classification system. They show the best use of land in areas which are not suitable for intensive or extensive agriculture. These consist primarily of areas characterized by sloping topography, shallow soils, and inclement weather. As illustrated on the map, these areas are typical of the foothill and mountainous areas of the County.

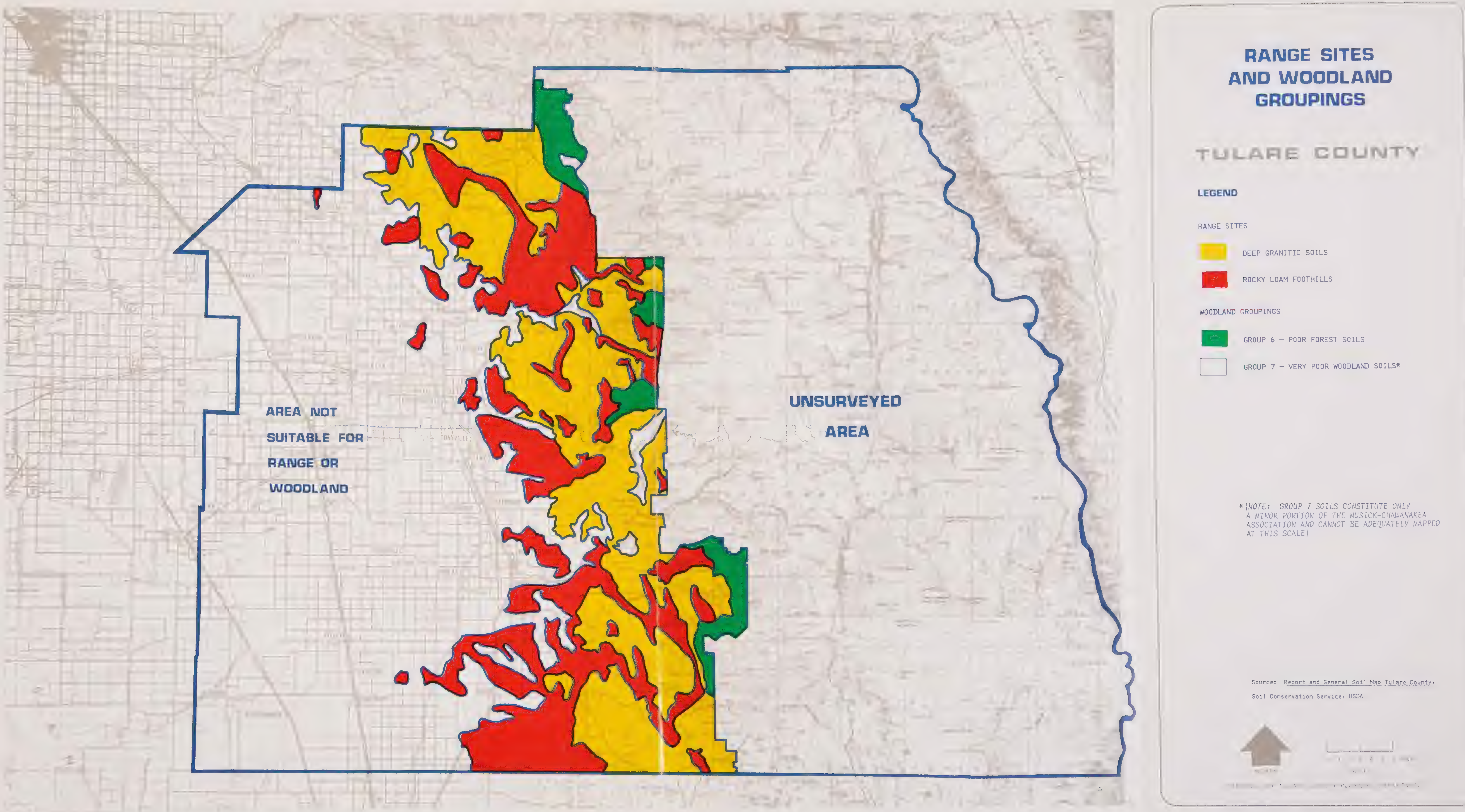
Range sites are used to group together soils which produce essentially the same kind and amount of forage for grazing animals. Soil scientists utilize range site evaluations to provide an inventory of forage potential of grazing land and to form a basis for proper management. In Tulare County the rangeland extends from the San Joaquin Valley, at about 400' elevation, to the boundaries of the National Forest, which vary in elevation from about 2500' to 4000'. At lower elevations, the cover is mostly open grasslands. However, when the average rainfall reaches about 16 inches, certain types of brush and trees such as cianothus, manzanita, and interior live oak, begin to appear. As elevations become higher the trees and brush increase in density and other species appear as rainfall increases. These areas contribute little livestock forage and generally detract from the potential production.

Two mapping units for range sites have been identified in the County. These include Deep Granitic Soils (DGS) and Rocky Loam Foothills (RLF). The definitions of these range sites are provided in the text.

Woodland suitability groups are classified in areas which are capable of producing similar kinds of wood crops (timber), that need similar management to produce their crops, and have about the same potential productivity. Unfortunately, the 1967 General Soils Survey did not extend beyond the western boundary of areas which are under Federal management. The Federal lands contain the majority of the good timber producing land in the County.

Two capability units for Woodland suitability have been identified in the County. The map indicates the location of Group 6 areas which are considered poor forest soils.

Group 7 areas which contain the worst woodland soils are also located in this area, but are too minute to show at this scale.



RANGE SITES
AND WOODLAND
GROUPINGS
TULARE COUNTY
LEGEND
RANGE SITES
DEEP GRANITIC SOILS
ROCKY LOAM FOOTHILLS
WOODLAND GROUPINGS
GROUP 6 — POOR FOREST SOILS
GROUP 7 — VERY POOR WOODLAND SOILS*
AREA NOT SUITABLE FOR RANGE OR WOODLAND
UNSURVEYED AREA
*(NOTE: GROUP 7 SOILS CONSTITUTE ONLY A MINOR PORTION OF THE MUSICK-CHAWANAKEA ASSOCIATION AND CANNOT BE ADEQUATELY MAPPED AT THIS SCALE)
Source: Report and General Soil Map Tulare County, Soil Conservation Service, USDA

Rocky Loam Foothills (RLF)

The soils of this site are well to somewhat excessively drained, moderately coarse to fine textured, shallow to moderately deep and moderately steep to very steep slopes. The permeability of the subsoil is moderate to slow. Available water-holding capacity is 1 to 8 inches and fertility is moderate. Natural vegetation is grass, grass-oak and pine. The desirable plants consist of soft chess, wild oats, bur clover and filaree. Perennial grasses are growing in the open or around and under scattered digger pine, blue or interior live oak. Less desirable plants are ripgut, brome, annual fescue, mouse barley grasses and annual lupine. Undesirable plants are fiddleneck, tarweed, turkey mullein, nitgrass, dogtail and silver hairgrass.

Deep Granitic Soils (DGS)

The soils of this site are well to somewhat excessively drained, moderately coarse to medium textured, moderately deep, moderately steep to very steep soils. The permeability of the subsoil is moderately slow to rapid. Available water-holding capacity is 3 to 6 inches and fertility is moderate. Natural vegetation is grass and grass-oak. The desirable plants consist of soft chess, filaree, wild oats, bur clover and perennial rye grasses. Less desirable plants are ripgutgrass, bromegrass, annual fescuegrass, mouse barley and annual weeds. Undesirable plants are fiddleneck, tarweed, Klamath weed, turkey mullein, dogtail and nitgrass.

G-5 WOODLAND SUITABILITY GROUPS

These capability units are determined by grouping soils that are capable of producing similar kinds of wood crops (timber), that need similar management to produce their crops and have about the same potential productivity. These units are based upon an identification of site quality, erosion hazard, equipment limitations, insect and disease hazard, wind throw hazard and adaptability to management. In Tulare County two mapping units have been rated and placed into suitability groups. Unfortunately, the 1967 General Soil Survey did not extend into the principal timber producing areas which are under Federal management. Thus, a complete picture of woodland capability in that area cannot be shown at this time.

A brief description of the two capability units which have been identified follows:

Woodland suitability group 6 - Its characteristics are medium site quality, slight to extreme erosion hazard, severe to moderate equipment limitation, severe to slight insect and disease hazard, severe to slight wind throw hazard and low to medium adaptability to management. The soils in this group are poor forest soils.

Woodland suitability group 7 - Its characteristics are low site quality, slight to severe erosion hazard, slight to severe equipment limitations, severe and moderate insect and disease hazard, slight to severe wind throw hazard, and low and medium adaptability to management. The soils in this group are very poor woodland soils.

The extent of these 2 areas in the County is shown on the Map following page 70B.

H. WATER MANAGEMENT

Surface runoff is an important factor in soil erosion and can create serious problems in urban development. Buildings, roads, and parking lots add impermeable material to any given area and generate increased local surface runoff. Excessive runoff may behave in violent ways and cause damage to property. If, for example, structures are built on soils having high runoff, planners should expect to cope with soil erosion problems. (Hydrologic groups C and D)

H-1. HYDROLOGIC SOIL GROUPS*

Hydrologic soil groups are soil interpretations used for estimating the runoff potential of soils on watersheds based upon the behavior of the soil during the intake of water in the latter part of a storm of long duration. This behavior is rated after the soil profile is thoroughly wet and has an opportunity to swell without protective vegetative cover. Engineers and soil scientists have classified the soil associations in Tulare County into four hydrologic groups:

Group A - Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well to excessively drained sands and/or gravel. These soils have a high rate of water transmission and would result in a low runoff potential.

*The Hydrologic Soil Group Map of the County is on the following page.

Group B - Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately coarse to medium textures. Those soils have a moderate rate of water transmission and moderate runoff potential.

Group C - Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water or (2) soils with moderately fine to fine textures and a slow infiltration rate. These soils have a slow rate of water transmission and a high runoff potential.

Group D - Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high shrink-swelling potential; (2) soils with a high permanent water table; (3) soils with a claypan or clay layer at or near the surface; and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission, and a very high runoff potential.

H-2 GROUNDWATER RECHARGE AREAS

Groundwater supplies approximately 40% of the irrigation water in Tulare County. Thus, the maintenance of a viable supply of groundwater is of fundamental economic importance to the County. As both agricultural and urban needs become greater in the future, the present balance of supply and demand probably cannot be maintained.

Groundwater bodies can be replenished by seepage from streams and underflow in the permeable materials flooding the riparian areas which extend into the valley. The groundwater is built up by this infiltrating water percolating through the soil by the processes described in Subsection B-1 of Chapter IV. Thus, areas possessing high permeability characteristics are potentially high quality groundwater recharge areas.

The map following p.74 indicates the best groundwater recharge areas in the Valley area of the County. All soils indicated on the map have a vertical conductivity of at least 0.5 feet of water per day based upon slope and texture composition.

This map can be used to guide the location of groundwater recharge reservoirs and water spreading sites. In addition, the map indicates areas where growers should be urged to use imported water beyond normal crop needs. The extra water applied in these areas of permeable soils will by-pass the plant root zone and eventually find its way into the underground basin. Unfortunately, the water for this type of program is probably available in about one out of five years. However, when it is available, growers should be urged to participate. These methods of applying large amounts of water in wet years are probably the only way, other than natural channels and ditches, in which the groundwater table can be raised in the Central Valley, unless deep well injection can be approved and afforded.

HYDROLOGIC SOILS

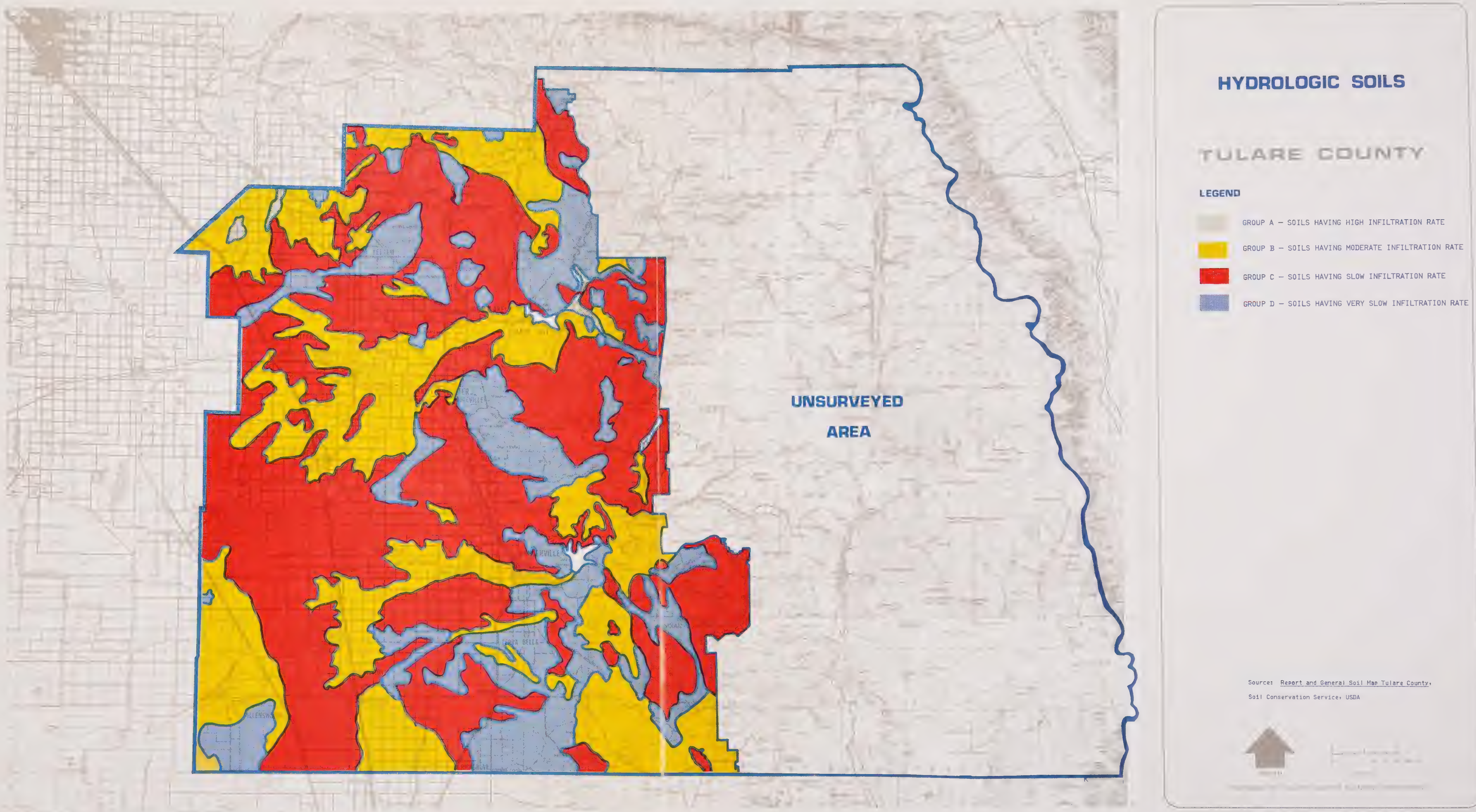
This map indicates interpretive ratings used for estimating the runoff potential of soils based upon behavior of the soil during the intake of water in the latter part of a storm of long duration. Knowledge of the runoff potential in any given area can be extremely important in planning for flood control structures and in dealing with soil erosion problems.

Buildings, roads, and parking lots add a tremendous amount of impermeable material to any given area and cause concentration of large amounts of runoff water. Such water may behave in violent ways and cause damage to property. If, for example, structures are built on soils having high runoff characteristics (Group C and D), planners should expect to cope with soil erosion problems.

Hydrologic soil interpretations can also be of value in determining suitable irrigation practices in an area. Knowledge of the rate of water intake can be useful in determining and planning for irrigation demand during drought conditions.

The map indicates that soils having higher infiltration rates are limited to the alluvial fan areas of the Kings River, Kaweah Delta, and the Tule River. The old Tulare Lake bed plus some of the mountain valleys are also included in this grouping. They are characterized by relatively coarse textured soils which have a relatively high rate of water transmission resulting in low to moderate runoff potential.

Group C and D soils are characterized chiefly by fine textured soil or shallow soils over nearly impervious materials resulting in slow rates of water transmission and very high runoff potentials.



HYDROLOGIC SOILS
TULARE COUNTY
LEGEND
GROUP A – SOILS HAVING HIGH INFILTRATION RATE
GROUP B – SOILS HAVING MODERATE INFILTRATION RATE
GROUP C – SOILS HAVING SLOW INFILTRATION RATE
GROUP D – SOILS HAVING VERY SLOW INFILTRATION RATE
UNSURVEYED AREA
Source: Report and General Soil Map Tulare County,
Soil Conservation Service, USDA

Source: USDA Soil Conservation Service

The two photos above illustrate soils having poor drainage characteristics. In these areas the water is removed from the soil so slowly that the soil remains wet for a considerable part of the year. These types of soils typically have a severe rating for most types of urban development. Poor drainage is caused by a combination of several factors including topography, generally low depth to water table, depth to bedrock or impervious layers, the texture of the soil, and the porosity of the soil. These soils also have severe limitations for septic tanks due to poor functioning of such tanks and leach lines under conditions of poor drainage, thus increasing the possibility of surface water pollution in agricultural areas from the tail water which results on soils having poor drainage. These stagnant waters also provide habitat for mosquito larvae. These soil conservation photos especially illustrate areas which are frequently flooded year after year. In these particular cases, man's activities have served to alter or modify the soils and thus have helped to cause flooding. The detailed soil survey, along with photographs like these, can be an aid to planners and engineers in foreseeing where such problems can be avoided in the future.

The two lower photographs illustrate the condition called "sheet flow" which is very characteristic of flooding where the topography is relatively flat. Each field to some extent becomes a catchment pan, retarding the flow of flood water to its ultimate destination downstream. This water will eventually drain from these areas; however, it may be delayed sufficiently to permit infiltration and groundwater recharge. Such flooding occurs, in part, because the soil is unable to absorb precipitation as fast as it falls or before it escapes as sheet wash.

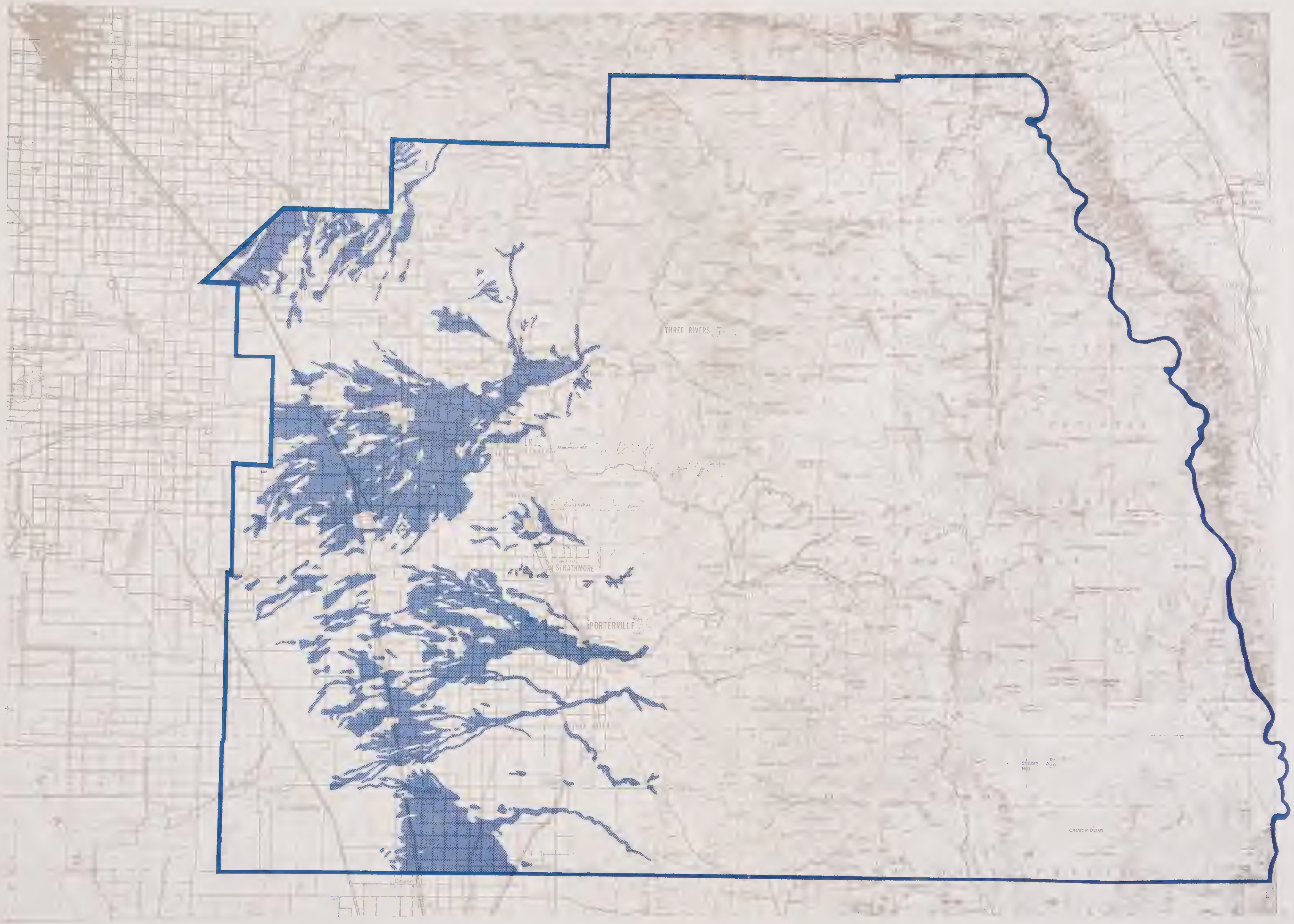
Source: USDA Soil Conservation Service

GROUNDWATER RECHARGE AREAS

This map indicates the best groundwater recharge areas in the valley area of the County based upon rates of water transmission identified from the Visalia and Pixley soil surveys. All of the soils indicated on the map have a projected vertical conductivity of at least 0.5 feet of water per day. The map indicates that these recharge areas are concentrated along the alluvial fans of the Kings River, Kaweah Delta, Tule River, Deer Creek, and White River.

The map has two very important functions: (1) it can be used to guide the location of groundwater recharge reservoirs into the best sites; (2) it indicates areas where planners and engineers should discourage large amounts of permeable surfaces such as streets, parking lots, etc.

The map also shows that nearly all of the major communities and urban areas in the County lie within these recharge areas. This map should be used to aid in the location of storm water retention basins within urbanized areas. Where choices are available, planners and engineers should seek to locate these types of facilities where they may be beneficial in groundwater recharge.



GROUND WATER RECHARGE AREAS

TULARE COUNTY

LEGEND

INDICATES SOILS HAVING A VERTICAL CONDUCTIVITY OF AT LEAST 0.5 FEET PER DAY

SOURCE: State Department of Water Resources

NORTH

0 1 2 3 4 5 6 MILES

SCALE

PREPARED BY TULARE COUNTY PLANNING DEPARTMENT

Chapter VII

Regulatory Systems and Guidelines

CHAPTER VII

REGULATORY SYSTEMS AND GUIDELINES

A - ORDINANCES RELATING TO SOILS

A-1 ZONING

Currently the Tulare County Zoning Ordinance (Ordinance No. 352 as amended) makes no mention of soil behavior in response to different types of land use. Soil survey information has long been used in subdivision regulations, the sanitary code, and in the administration of the California Land Conservation Act. Information regarding soil capability for agriculture has also been of significant value in determining long range planning policy. Until recently, however, it has not been used extensively in zoning administration.

At present, soils information is used solely as an element in the facts and findings report prepared by the planning staff for conditional use permits, zone changes or any other permit administered under the zoning ordinance. The soils information used in these reports is extremely useful in providing local decision-makers full knowledge of the effects of certain land uses in a given area. However, many forms of construction and development can take place without benefit of review by local decision-makers (assuming compliance with existing zoning). For example, a septic tank and filter field may be installed in almost any zoning district if it complies with the sanitary code and other related laws. Soil factors are rarely considered unless the septic tank is situated within a recent subdivision or parcel map for which a soils investigation had been performed or is located in the foothills where uniformly severe limitations exist. How is it possible to provide meaningful development controls in all areas where soil behavior may be severely limiting to certain types of land use?

Experience has shown that the detailed soil survey, such as that prepared by the U.S. Soil Conservation Service, is extremely useful in the development and application of zoning ordinances, and in their explanation to local citizens. Since soil is a major component of land, knowledge of the locations and responses of soils to various land uses can be an invaluable element of a zoning ordinance. Use of soil suitability analyses in the ordinance allows land use to be better fitted into the natural landscape. It gives the ordinance a stronger factual basis than would otherwise be possible.

1. The Legal Basis - The use of soils surveys in zoning ordinances is a relatively new concept which did not surface until the environmental management movement became a fixture in planning processes throughout the nation. Because this concept has only recently evolved, the legal validity of use of soil survey data in zoning ordinances is an important consideration. Analysis of the legal basis depends upon the following:

   a. State zoning enabling legislation.

   b. Judicial interpretation of the statutes.

   c. Specific uses made of soil surveys in the ordinance.

   d. Administrative techniques used.

   e. Application of the ordinance to actual situations.

   The broad objectives stated in the State Planning and Zoning Act are all inclusive and, thus, it would appear that use of soils information in zoning ordinances is not inconsistent with State statutes. However, the basic test of zoning is its reasonableness and its consistency with local general and specific plans. Reasonable use of soil survey information in zoning depends upon a recognition of its potentials and its limitations. These potentials and limitations must then be realized in the structuring of the ordinance, its administration and the application of it to actual situations. Furthermore, this must be accomplished within the framework of goals and objectives prescribed in the Environmental Resources Management Element of the Area General Plan.

2. Limitations - Two specific USDA surveys have been issued for Tulare County - The Visalia Area Survey (1940) and the Pixley Area Survey (1942). These surveys cover only the valley portions of the County and were developed primarily for agricultural use and interpretations. They contained no interpretations for urban development. They were also issued before the new system of soils classification was adopted for use by USDA in 1965. For these reasons, these existing soil surveys are now considered out-of-date and inconsistent with modern soil survey practice.

Recognizing these deficiencies, the Visalia office of the Soil Conservation Service completed a general soil survey including soil suitability interpretations for urban uses in 1967. This more recent survey was largely based upon the two existing surveys and upon new investigative work carried on in the foothill area of the County. This latter survey is thus more extensive and includes most of the County, excepting areas under State and Federal jurisdiction.

It is felt that because the general survey provides the most recent information available (1967), it should be used as the basis for developing zoning controls closely related to soils.

The soils in this report (reproduced in Chapter V) are generalized and are not as precise as in a detailed soil survey. It is important to note that the groupings of soil series into associations in the general soils report was largely based upon similar characteristics and behavior. However, because the intensity of investigations is low, the range of soil conditions within map units may vary enough to allow different soil responses to given land uses. This limitation must be recognized in devising appropriate zoning controls based upon this survey.

Again, not all land use problems are soil-related. Problems involve factors other than soils. Thus, ordinances and policies based upon soils data must be designed so that they are an integral part of the comprehensive planning process.

Two principles must be adhered to in the application of soils suitability studies through zoning as a regulatory device:

a. The regulatory provisions must set forth rules sufficiently precise to avoid possibilities of arbitrary decisions.

b. These rules must bear a reasonable relationship to actual conditions within the physical environment.

These principles provide guidelines that are important to remember when developing regulations based upon soils data. It must be recognized that the inherent physical properties of soils do not always correspond to the sharp demarcations that are most desired. Therefore, it is impossible to develop a soils map which precisely represents all soil conditions and characteristics at all places.

Any ordinance based upon soils information requires a certain degree of administrative flexibility so that it allows for situations in which a final solution to soil-related problems made in advance of acquiring precise soils information would be inappropriate. For example, a similar case was made recently for the need for administrative flexibility in the application of flood plain zoning. In recognizing this need, the Board of Supervisors approved policy which set standards by which property owners could obtain zoning changes without fees if it could be proven that the flood frequency maps upon which the zoning was based were incorrect. Similar policies need to be established with regard to the use of soil survey maps as the basis for zoning. In order to provide the flexibility needed, the ordinance should at least contain the following elements:

a. A statement of standards sufficiently precise to isolate the facts that have to be found.

b. A hearing procedure wherein the applicant has an opportunity to present contrary factual data (this is an ongoing function under the current zoning ordinance).

c. The availability of technical personnel (knowledgeable in soil science) to the Planning Commission and Board of Supervisors. (This may be accomplished through memoranda of understanding with the Soil Conservation Service and any other applicable agency.)

Most modern zoning ordinances prescribe performance standards for many types of uses which may otherwise create adverse effects upon the surrounding environment. The same principles hold true for the development of different types of land uses on different types of soils. The soil interpretations presented in Chapter VI provide a basis from which soil standards suitable for this County may be determined. These standards may then be used in creating zoning categories based upon soil performance in response to different land use. The techniques for accomplishing this are discussed in the following subsection.

3. Zoning Techniques - The question immediately arises, "how can soils information be used in zoning?" The first step is to determine which categories of soil limitations are most severe and difficult to overcome within the Tulare County area. If these categories can be linked to soil characteristics which have geographic continuity, then zoning may be the most feasible regulatory device for dealing with the problem. Within the context of this document a variety of soil problems, interpretations and characteristics have been defined. Some of the more significant characteristics include:

   a. poor drainage
   b. shrink-swell behavior
   c. flood hazard
   d. erosion potential
   e. bearing strength
   f. suitability for on-site sewage disposal systems
   g. suitability for sewage lagoons or solid waste disposal sites
   h. suitability for transportation systems

   All of these are special soil problems requiring special solutions for urban development, as well as many types of non-urban land uses. Where these problems are severe, exclusion of intensive development may well be the best long-range answer especially in view of all the costs involved not only to the developer and to the public through disaster programs, but to the environment and ecology of the County as well. How may zoning serve to enforce these concepts? Three general techniques are possible:

   a. Creation of primary zoning districts.

   b. Creation of overlay zoning districts.

   c. Developing a special soils section in the ordinance.

   The pros and cons of these techniques are discussed in the following sections.

3-1 CREATION OF A PRIMARY ZONING DISTRICT

A primary zoning district could be used in areas where nearly all types of development would be adversely affected by soil problems. These problems would have to be of such magnitude as to preclude most development from occurring. Primary flood plain zoning is an example of attempts to define particularly hazardous areas and prevent those types of development which are inconsistent with the hazard from locating there. However, the application of primary flood plain zoning requires precise engineering and hydrological data which is necessary to determine exact flooding boundaries. Furthermore, the hazards associated with high frequency flood areas are quite extensive, and, are usually confined within a small area adjacent to rivers and streams. Thus, a primary zoning district is justified.

Such may not be the case regarding hazards generated by soils. Hazardous soil behavior may extend over large areas of the County within which many activities may be taking place. To arbitrarily exclude development over such large areas does not seem reasonable or proper, especially when other factors such as accessibility, urbanization potential and existing services are given consideration. Also, the fact that the County does not possess an up-to-date detailed soil survey cannot be overemphasized. The precise soils interpretations necessary to effect a soils zoning ordinance currently exists only in generalized form.

Thus, at present it would appear to be inappropriate to effectuate primary zoning districts based upon the limited soils data currently available. The option of developing primary districts, however, does hold promise for the future whenever a new detailed soil survey is made. Specifically, the primary district approach may be most appropriate for preserving areas of severe mass movement or other geologic hazards. A detailed soils survey used in combination with geologic studies in mountainous and foothill areas is needed to provide a firm factual basis for the implementation of such an ordinance. Interim use of the principles, however, may be applied to standards for subdivisions and use permits, or for small area rezoning.

3-2 CREATION OF OVERLAY ZONING DISTRICTS

The creation of a series of overlay soil hazard districts appears to be the best technical approach, given the limited soils data currently available. This approach provides that if soils are not a special problem, the basic uses permitted are those established by the primary zoning district. In areas where severe problems have been identified, overlay districts would be established in combination with one of the primary use zones. The overlay district would not contain a list of permitted uses. Instead, it would be designed to provide supplementary controls over land use in addition to those of the primary zone, with certain specified additions or exceptions.

A good example of such a zoning technique is the secondary flood plain zone which can only be used in combination with other zones. It specifies certain supplementary controls over those uses allowed in the base or primary zone that insure any development in these areas is properly flood-proofed or protected from flood hazards. It is technically feasible to construct a series of overlay districts related to soil problems which function in a similar manner. Based upon soils information currently available, a series of soil overlay districts may be developed and implemented for the following soil problems or soil-related behavior.

* Areas having severe soil limitations for septic tank filter fields or seepage pits

* Areas characterized by steeply sloping topography with moderate, high or very high erosion hazards

* Areas subject to sheet flow or frequent ponding of flood water

* Areas whose soils have high shrink-swell behavior or low bearing strength for foundation support

* Areas having severe soil limitations for sewage lagoons and/or solid waste disposal sites

The overlay zoning technique need not only be used to define and control development within areas which exhibit hazardous behavior. A secondary function might be to delineate areas where man's actions may serve to destroy or endanger an important natural resource or conversely, to enhance it. In this sense, overlay districts may be created to set additional standards for development in areas such as:

* Areas having a high rating for groundwater recharge as indicated on the groundwater recharge map or other geologic studies.

* Areas having special values for recreational development based upon soil suitability analysis accessibility and demand

* Areas having a high rating for source of construction materials such as sand and gravel, where extraction may be appropriate

* Areas having little or no limitation for intensive agriculture or specialty crops.

How would overlay districts work in practical application? This question is, perhaps, best answered through use of a hypothetical example. If an overlay zone were created to exclude septic tank filter fields or seepage pits from unsuitable areas, it would probably permit, as a matter of right, any use permitted by the primary use zone which does not require a subsoil sewage disposal unit. Any use requiring an on-site system would have to be made a Special Exception (or Conditional Use) and the conditions attached to such uses specified in the ordinance. A modified Administrative Use Permit procedure may be the most practical means of processing exceptions. The ordinance would specify those conditions in which no subsoil sewage disposal units should be allowed and under what conditions Special Exceptions would be granted. The decision to create such a district should at first be based upon the following determinations:

* That land use problems can be traced directly to soil behavior as determined through soil survey analysis.

* The limitations imposed by the soil problem may, in some cases, be easily overcome with proper corrective action.

* Not all land uses allowed in the base zone are affected. (If all land uses were affected, then a new primary zone would be appropriate.)

* The soil units do not have high intrinsic value for other uses (esthetic or scenic, wildlife habitats, recreation, etc).

* Zoning is a feasible device for dealing with the problem in conjunction with existing sanitary code, building code, subdivision ordinance and water quality standards.

* The application of the zoning district is consistent within the framework of the goals and objectives of the Environmental Resources Management Element and other respective elements of the Area General Plan.

There is one problem, however, in the use of the overlay zoning technique as regulatory devices for difficult soil areas. This problem lies in administrative and political difficulties involved in changing or amending the zoning map.

The County cannot afford to wait years for this to happen. State law requires that zoning ordinances must be consistent with all elements of the General Plan by January 1, 1974. If overlay zoning techniques appear to be the most feasible method of generating appropriate building practices in hazardous soils, then it would be necessary to find some practical means of achieving speedy implementation. Adopting the overlay districts countywide as an emergency measure is one possibility that may be used to meet this end. After these regulations become enforceable, the Planning Department would be instructed to initiate permanent overlay rezoning procedures on a regional basis.

3-3 SPECIAL SOILS STANDARDS SECTION IN THE ZONING ORDINANCE

This method has many similarities to the overlay district technique except that soil data is not expressed in the zoning map. Thus, this technique does not require the rezoning procedures that would otherwise be necessary. Under this format, a special soil standards section would be added to the zoning ordinance text which establishes standards and procedures for building in difficult soil areas. This process is identical to the system now used to apply building, health and road standards. The same categories of soil problems and soil related behavior as may be appropriate for overlay zones would be included here. Instead of adopting a zoning map, the special section would formally state that the 1967 General Soils Map as prepared by the Soil Conservation Service would be used as the general basis for all decisions administered under the ordinance and detail maps showing abstractions from the general map would be authorized for use in detailed administration. This reference procedure would facilitate the administrative process of switching to the detailed soil survey, when it becomes available. Under the overlay district procedure, numerous changes of zones would become necessary whenever this informational base was changed or improved.

An example of how a special soils section may work in practice is improvised as follows. Assume for the moment that the special section includes restrictions directed at soils unsuitable for septic tank filter fields or the subsoil dispersal of sewage effluent. These restrictions would apply to those areas shown on the 1967 General Soils Map as having severe limitations for septic tank filter fields and detailed on a separate reference map. All soil absorption sewage disposal systems would be prohibited in these severely difficult areas, subject to certain conditions. In order for the applicant to install a septic system, he would have to meet the following requirements:

* On-site soil investigations including percolation tests must be made.

* Certification by the Health Department that there is sufficient area, suitable for the system.

* The design of the proposed system indicates that all limitations will be overcome to the satisfaction of the Building Department.

These requirements would be applicable to any use which may at some time require the use of an on-site sewage disposal system. In other words, a dwelling or dwelling site should not be created in an unsewered area unless it is known in advance of permit approvals and construction that the soils on the site are adequate for sewage disposals.

The standards section should, of course, be accompanied by an appeal procedure wherein the applicant is afforded the right to submit evidence contesting the findings of the County staff. This procedure could be administered through the Planning Commission as an appeals board, a separate appeals board, or the Board of Supervisors which would have the power to affirm, or reverse the staff's decision.

The three implementing techniques described herein have many similarities. It is conceivable that all three procedures may be appropriate in Tulare County. These are feasible regulatory devices for dealing with the problems of difficult soil areas. Action is needed to implement the concept.

One technique which can be used to limit development on hazardous soils is to require lower densities than would otherwise be permitted by the zoning ordinance in such areas. Section 14.5 of the Zoning Ordinance provides the mechanism to accomplish this. The section reads as follows:

SECTION 14.5: SPECIAL COMBINING ZONE

A. PURPOSE

This combining zone is intended for use in areas where land topography, soil conditions, impending development or other factors indicate a need for a zone with minimum lot areas of a larger size than the minimum lot area specified in this Ordinance for a particular zone.

B. ZONE REGULATIONS

When this combining zone is applied to property in conjunction with another zone set forth in this Ordinance, a new zone is thereby created which shall have the minimum lot area requirements established pursuant to this Section and all of the other requirements for the combined zone shall be those which are applicable in the zone with which this zone is combined.

C. LOT AREAS

The minimum lot area in any zone established by the use of this Section shall be as indicated on the Zoning Map. Such minimum lot areas shall be shown on the Zoning Map by a number following the zone symbol, which number, multiplied by one thousand (1,000), shall designate the minimum lot area in square feet applicable to the zone.

The provision of this section may be implemented for a variety of reasons, one of which is the existence of difficult soils. Care must be used, however, to insure that the density designated under this section is consistent with both the hazards identified and the land use plan for the area.

One of the important products of the *urban capabilities* study procedure described in this chapter is the optimum density of development at various places throughout the County. When the outcome of this study is combined and compared with other important planning policies, a strategy framework for optimum growth and development will emerge. It is recommended that the density control technique already provided in Section 14.5 be used to achieve optimum levels of growth.

A-2 SUBDIVISION OF LAND

The existing County Subdivision and Parcel Map Ordinance (Sections 7000-7125 of the Ordinance Code) contains many specific requirements regarding the use of soils information as a determinant in subdivision design. Generally, these requirements call attention to the need to evaluate all soil related factors which could have an effect on the development of lands administered under the Ordinance. Such factors include:

(a) Suitability for on-site sewage disposal systems

(b) Soil drainage characteristics

(c) Surface runoff

(d) Condition of water table

(e) Suitability for road fill and building support

(f) Shrink-swell

(g) Depth to bedrock, and other soil factors

The County of Tulare has been acclaimed for its straightforward handling of soil related problems in subdivision design. For example, this County was one of the first in the State to require that the size of lots be a function of topography and soil characteristics. This is accomplished through the use of the slope-area diagram shown in Figure 11

Another section of the Ordinance requires the preparation of a preliminary geological-hydrological report to accompany the filing of a Tentative Subdivision or Parcel Map. This report provides a basis for determining the adequacy and safety of the water supply, the stability of the soils for subdivision and the suitability of the site with regard to other geological/physical factors. It must include a determination of the geological structure of the site identifying potential geological hazards such as: soil stability for cuts and fills, seismicity, probability of adequate groundwater supply, potential erosion - sedimentation problems and other pertinent physical factors affecting the site or surrounding area.

A final geological-hydrological report is required for subdivisions (and parcel maps at the direction of the Parcel Map Committee) as well. The purpose of the final report is to provide a more definitive evaluation of problems identified in the preliminary report just prior to approval of Final Maps.

If the final geological-hydrological report indicates the existence of critically expansive or loosely deposited soils or a soil problem which, if not corrected, could cause structural damage, a soil investigation must be undertaken by a registered civil engineer or geologist. The purpose of this investigation is to determine the best corrective action (if any) to prevent structural damage on all lots. The corrective action, if approved by the County Building Engineer, becomes a condition of approval for all building permits subsequently issued in that hazard area.

These examples serve to illustrate the County's deep concern for the problems inherent in developing steeply sloping or difficult land. The following section describes in detail the various sections of the Ordinance dealing with physically-related problems in subdivision design. A short analysis, in italics, follows each section of the Ordinance. This is intended to provide further insight into the mechanics of implementing the Soils Element and to suggest improvements to it.

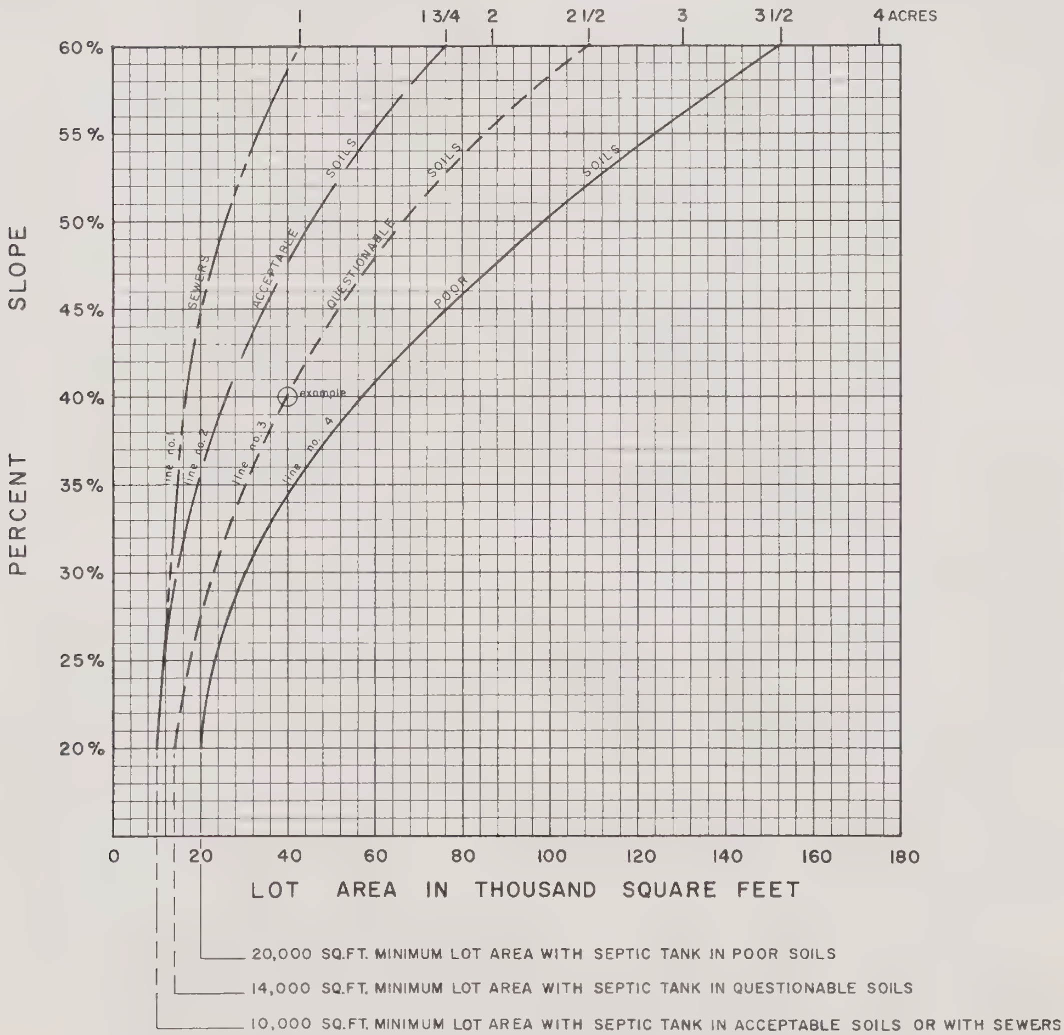
SECTION 7026.2 LOTS: SIZE: MOUNTAINOUS AREAS:

The minimum lot sizes for single family dwelling units in subdivisions in mountainous areas shall be based upon the following Slope-Area Diagram:

Figure 11

SLOPE / AREA DIAGRAM

BASED ON SOIL, TOPOGRAPHICAL, HYDROLOGICAL AND GEOLOGICAL CHARACTERISTICS



EXAMPLE: QUESTIONABLE SOILS WITH A 40% SLOPE WOULD REQUIRE A LOT AREA OF 40,000 SQUARE FEET.

Source: Tulare County Planning Department

(Domestic water for mountain subdivisions may only be supplied by means of a community system)

When computing the minimum lot size, the subdivision shall be divided into separate areas which have generally similar soil characteristics and generally similar slopes. Then the determination of soil type...and the computation of the percentage of slope...shall be computed separately for each of said areas and the (slope-area) diagram...shall then be applied separately to each area to determine the (minimum) lot size applicable within that area...

SECTION 7026.3 SAME: DEFINITIONS FOR SLOPE-AREA DIAGRAM:

The following definitions shall govern the use of the (Slope-Area) diagram:

(a) The term "acceptable soils" means soils having the following characteristics:

   (1) Percolation test results whose median rate is fifteen (15) minutes per inch or less, said percolation tests to be conducted in accordance with procedures and standards established by the Federal Housing Administration in effect on the 27th day of May, 1969.

   (2) An average depth of soil mantle of seven (7) feet. Said soil mantle shall consist of coarse or fine loam, sandy clay, or any combination of the above.

   (3) Groundwater level will not affect the sewage system and is a minimum of ten (10) feet below the intended depth of the leaching field at the time of the highest water table. Also, the terrain to be utilized for a disposal field is not subject to flooding or ponding of water.

(b) The term "poor soils" means soils having the following characteristics:

   (1) Percolation tests results whose median rate is forty (40) minutes per inch or more, based on the procedures and standards referred to in subsection (a) above.

   (2) An average depth of soil mantle of four (4) feet or less and/or excessive amounts of clay or critically expansive soils.

(c) The term "questionable soils" means all soils which do not come within the definition of "acceptable soils", and do not come within the definition of "poor soils".

SECTION 7026.5 SAME: DIAGRAM: COMMUNITY SEWAGE SYSTEMS:

When a community sewage system is to be provided in a subdivision in a mountainous area, the minimum lot size may be reduced down to, but not beyond, the minimum lot area prescribed by Line No. 1, in the (Slope-Area) diagram....

The Slope-Area diagram procedure used to determine the minimum lot size for subdivision design is unique among California Counties. The use of this type of system can, with detailed field investigation, provide a density standard which recognizes the limitations of the land and the needs of the people and developer. This procedure of site analysis has been a requirement for tentative mountain subdivision maps since June, 1969, and for tentative parcel maps in mountainous areas since March, 1972. There is no justification at present for revising the Slope-Area diagram as currently drawn. However, there does appear to be room for future improvement in the definitions of soil types used in the diagram. The following illustrates how the soil classifications may be improved.

(a) Soils classified as "poor" should also include those soils having a seasonal water table at less than 5 feet below the intended depth of the leaching field, and soils subject to flooding or ponding on an average occurrence of once or more every 50 or 100 years for a duration of 48 hours or more.

(b) The definition of "questionable soils" needs to be presented in more precise terminology.

(c) The terms "acceptable", "questionable" and "poor" should probably be amended to reflect the terminology used in the Soils Element. Thus, the soil types would be described in terms of the range of limitation: slight, moderate and severe.

Before an evaluation of the criteria used to establish the soil type, consultation should be sought with qualified soil scientists and civil engineers.

SECTION 7026.6. LOTS: SIZE: NON-MOUNTAINOUS AREAS:

For subdivisions which are not in mountainous areas, the lot sizes shall not be less than the minimums specified in the Zoning Ordinance and they shall comply with the minimum requirements in this section as well. The criteria for determining minimum lot areas in non-mountainous areas thus summarized:

6000 sq. feet	for interior lots if both water and sewage disposal are provided by means of community systems
7000 sq. feet	for corner lots if both water and sewage disposal are provided by means of community systems
8000 sq. feet	if water is provided by individual wells and sewage disposal is provided by a community system
12,500 sq. feet	if sewage disposal is provided by individual systems on the lots and water is provided by a community system
43,560 sq. feet (1 acre)	if both water and sewage disposal are provided by individual systems on the lots

These minimum lot areas are based on the subdivision having an adequate soil mantle depth and soil permeability, and larger lots shall be required when the subdivision does not meet any of these qualifications.

The Subdivision Ordinance does not prescribe how adverse the soil conditions have to be before larger lots may be required. In addition, there is no rule guiding the actual additional amount of area that may be needed. These determinations are left to the Health Officer who reviews the proposed subdivision (or division of land). Given a detailed soil survey, these determinations can be easily made in advance of any development proposal. If the optimum development density is known, the appropriate density standard could be provided through the Zoning Ordinance. Furthermore, such a procedure need not be limited to non-mountainous areas. A detailed soil survey coupled with precise topographic maps can provide sufficient basis for determining optimum density using the slope-area diagram procedure. (Essentially applying soils data only where slope is insignificant). As previously described, a mechanism for density control currently exists under the provisions of Section 14.5 of the Zoning Ordinance.

SECTION 7031.2. DRAINAGE: PONDING LOTS:

(This section establishes the requirement and specifications for ponding lots where it is not feasible to provide an adequate system of drainage outside the subdivision site).

This section and the relevant improvement standards do not take soil characteristics into consideration in the design specifications of ponding lots. Ponding lots underlain by relatively impervious soils cannot be expected to function as efficiently as those underlain by porous soil types. This section should be amended to require consideration of soil porosity in the location and design of ponding lots.

SECTION 7033. SEWAGE DISPOSAL: SANITARY SEWER SYSTEM:

All lots within a subdivision shall be connected to a sanitary sewer system.... if the trunk line or access point is located within 1320 feet of any portion of the subdivision.

SECTION 7033.1. SEWAGE DISPOSAL: SEPTIC TANKS:

If connection to a sanitary sewer system is not required under Section 7033, provision shall be made for adequate sewage disposal by individual systems unless the body taking final action determines that such a method of sewage disposal will not be adequate for the subdivision or would be in violation of Sections 7008, 7008.5 or 7009 (requires compliance with general and specific plans, specific plans for Land Projects and specifies certain criteria under which land may not be subdivided). A letter shall be submitted by the County Health Department certifying that field investigation, tests and reports show that ground slopes and soil conditions will allow satisfactory sewage disposal by this method. No portion of an individual sewage system shall be maintained within a selected flood line unless protected by flood control devices or any portion thereof be located closer than 50 feet to any surface water source (or within 100 feet of) any public or private well site or impounded body of water.

SECTION 7033.2. SEWAGE DISPOSAL: COMMUNITY DISPOSAL SYSTEM:

If the body which takes action on the final map determines that individual sewage systems shall not be used pursuant to Section 7033.1 the subdivider shall construct a community disposal system, unless it is determined that such a community disposal system is not feasible because of unsuitable soil or topographical conditions or other reasons.

These sections should also include an alternative provision for sewage system connection for any subdivision located on soils having severe limitations for septic tank filter fields. This requirement should be mandatory for subdivisions situated within Urban Improvement Areas

SECTION 7042. HAZARDOUS AREAS:

Areas subject to slides or other similar hazards to public safety shall not be subdivided unless preventative measures have been taken by the subdivider, under the direction of an engineering geologist, soils scientist or registered civil engineer.

There may be areas wherein the geologic hazards are such that no economically acceptable methods of mitigation are possible. This section indicates that any hazard can be overcome, however; some provision must be made to allow prohibition of certain kinds of development where hazards cannot be reasonably expected to be overcome.

SECTION 7043. PONDING AREAS:

Areas which are subject to the ponding of surface water shall not be subdivided until necessary measures have been taken to prevent such ponding.

Although the intent of these sections appears far reaching, the actual statements are ambiguous in that no criteria are defined which establish what is or what is not a hazardous area or ponding area. Better definitions are needed to insure consistent administration of these sections. The Seismic Safety Element, scheduled for completion during the third year Environmental Resources Management program should provide a more accurate basis for enforcing the concept suggested by Section 7042. Soils rated as being poorly or very poorly drained should be thoroughly examined for compliance with Section 7043. Some areas may be actively sought for groundwater recharge.

SECTION 7052.5. PRELIMINARY GEOLOGICAL-HYDROLOGICAL REPORT:

(a) The preliminary map shall be accompanied by a preliminary geological-hydrological report prepared by a registered civil engineer or a registered geologist.

(b) If the Planning Director determines that sufficient accurate information is already available with regard to any or all of the matters to be covered in a preliminary geological-hydrological report, he may waive a report on such matters.

(c) The preliminary geological-hydrological report shall contain a general analysis of the following factors with regard to the property to be subdivided:

(1) Geological structure of the property, including the identification of all potential geological hazards which can be ascertained.

(2) A general report on the several matters that will be covered in more detail in the final geological-hydrological report to be submitted at a later date pursuant to Section 7063.2.

(3) Stability of soils for cuts and fills.

(4) Seismicity.

(5) Probability of a permanent groundwater supply on the property adequate to supply the anticipated needs of the subdivision.

(6) Potential erosion and sedimentation problems.

(7) Other special factors deemed to be pertinent to the proposed subdivision by the person preparing the report.

(d) The preliminary geological-hydrological report, and the final geological-hydrological report, if required, shall serve as a basis for decisions pertaining to adequacy and safety of the water supply, the suitability of soils for subdivision and the suitability of the site with regard to other geological characteristics.

SECTION 7063.2. FINAL GEOLOGICAL-HYDROLOGICAL REPORT:

(a) The tentative map shall be accompanied by six (6) copies of a final geological-hydrological report prepared by a registered civil engineer or registered geologist.

(b) If the Planning Director determines that sufficient accurate information is already available with regard to any or all of the matters to be covered in a final geological-hydrological report, he may waive a report on such matters.

(c) The final geological-hydrological report shall contain a more definitive evaluation of the factors contained in the preliminary geological-hydrological report prepared pursuant to Section 7052.5 of this Chapter and shall cover the following matters:

(1) A detailed geological map indicating bedrock, soil, alluvium, faults, sheers, permanent joint systems, seeps or springs, soil or bedrock slumps, landslides and other failures.

(2) All proposed grading, topographical relief, drainage, geological and soil types, and the effect of proposed grading on the site and adjoining properties.

(3) Recommendations regarding the solution of possible erosion and sedimentation problems.

(4) Specific recommendations for the correction of all known or anticipated geological hazards.

(5) Conclusions regarding the chemical and bacteriological quality of the water source proposed to be used for domestic supply purposes in terms of the current standards set forth in Section 7001 et seq. of Title 17 of the California Administrative Code.

(6) An analysis of the effects of water from rainfall, irrigation, individual sewage disposal systems, or other probable sources from the subdivision and adjoining properties, wherever such water is likely to reduce the subsurface stability or cause erosion.

(7) An outline of all geological and soil problems, and proposed solutions to these problems, indicating wherever proposed grading or other proposed improvements may adversely or beneficially affect the existing or future stability of the area.

(8) A comprehensive geological examination of the groundwater characteristics of the property.

(9) If the supply of water for domestic or fire suppression purposes is to be provided by wells, a sufficient number of test wells shall be drilled to permit reasonably accurate estimates regarding the occurrence, availability, and quality of groundwater. The Planning Director shall determine the location and required number of test wells. In selecting the lots for test wells, the Planning Director shall require that at least five percent (5%) of the lots be tested and may utilize a table of random numbers to select the lots.

(10) A map showing the location of all wells drilled pursuant to paragraph (9), including depth to water table and anticipated yields.

(11) If individual sewage disposal systems are to be used in the subdivision, the report shall include recommendations regarding the location, type and size of such individual systems. Such recommendations shall be based upon the geological and soil analysis included in the report and shall take into consideration the uses allowed under existing or proposed zoning. If a community sewage system is to be used, the report shall also set forth recommendations regarding the disposal of the effluent from the terminal treatment facility and conclusions concerning the effect of such disposal in terms of the current standards of the California Regional Water Quality Control Board for the Central Valley Region.

(d) The final geological-hydrological report, if required, shall serve as a basis for decisions pertaining to adequacy and safety of the water supply, the suitability of soils for subdivision and the suitability of the site with regard to other geological characteristics.

The requirements for preliminary and final geological-hydrological reports is a recent addition to the subdivision ordinance (effective April 1, 1973). At this time it is too early to determine the effectiveness of these new regulations. It would appear, however, that the range of information required in these reports will provide a basis for analyzing the physical characteristics of a site. The same requirements may also be applied to proposed parcel maps as well at the discretion of the Parcel Map Committee.

In view of the fact that more lots are now formed in unincorporated parts of this County by parcel mapping than by "subdividing" it is most important that such data be supplied where general soils and topographic data indicate possible problems.

The Soils Element should serve as the yardstick against which soil-related problems identified in these reports may be assessed. For example, the soil interpretations contained in Chapter VI provide a check against the conclusions found in these reports. The soil interpretation maps can also be used in determining if a waiver of these requirements is justified.

(c) A log of soil formations and groundwater level as determined by test holes dug in close proximity to any proposed seepage pit or disposal field, together with a statement of water absorption characteristics of the soil at proposed site as determined by approved percolation tests.

This requirement, however, is not mandatory and is rarely applied as a condition of approval of a building permit outside of areas subdivided under current provisions or in foothills and mountainous areas where severe limitations uniformly exist. Soil suitability maps used for land division and use regulation may be of use in making this section of the Code more effective, especially in Valley areas.

For example, if the area in which a septic tank filter field is to be installed shows up as having severe limitations for absorption of domestic sewage, the regulations described in Section 1109(c) should take effect. On the other hand, if only slight limitations were evident, no tests would be required.

If the tests confirmed the inadequacy of the soils to adequately absorb domestic sewage, the County Building Engineer retains the authority to prohibit issuance of a building permit. These provisions are found, under Sections 1111(e) and (f) of the Uniform Plumbing Code and read as follows:

Section 1111 Private Sewage Disposal (General)

(e) No property shall be improved in excess of its capacity to properly absorb sewage effluent in the quantities and by the means provided in this code.

(f) When there is insufficient lot area or improper soil conditions for adequate sewage disposal for the building or land use proposed, and the Administrative Authority so finds, no building permit shall be issued and no private sewage disposal shall be permitted. Where space or soil conditions are critical, no building permit shall be issued until engineering data and test reports satisfactory to the Administrative Authority have been submitted and approved.

Within these sections, the County retains the tools necessary to implement the basic concept that individual septic systems be located only upon acceptable soils. However, before this concept can take effect, several problems will need to be resolved.

One problem which immediately arises is the notion that substantial rights to use and enjoy personal property could be withheld under this concept. Obviously, if any building permit which required a private sewage disposal system could be prohibited in certain hazard areas, the range of uses allowed in that area would be significantly diminished. Therein lies a basic controversy which may never be entirely resolved. How many rights to use property may properly be restrained in the public interest and in the name of preservation of environmental quality. It is not believed appropriate to attempt to answer this fundamental question in the confines of this report, although it is given more attention in the *policy* section of this chapter. In the specific case of soils unsuitable for septic tank filter fields, it must be emphasized that most of these areas are found on lands used for intensive agriculture or in marginal foothill areas. Thus, the primary economic use of these lands will probably be unaffected by the implementation of the concept. In certain cases, where unacceptable soil occurs within urban area boundaries, it may be more appropriate to consider development of public sewage systems as opposed to private (individual) systems.

Another problem associated with this concept lies in the accuracy of currently available soils information. Again, the immediate need to acquire a modern detailed soil survey for the County, must be expressed. The soil suitability maps contained in this report are entirely based upon information supplied by the 1967 General Soil Survey. However, because the 1967 report aggregates soils into associations having "similar" characteristics and behavior, there exists a margin of error that cannot be precisely defined in any specific case. Thus, implementation of the appropriate sections of the Uniform Plumbing Code must bear this in mind. Thus, for example, it cannot be recommended that under *no* conditions should building permits requiring individual septic systems be approved within areas shown as having severe limitations for septic tank filter fields on the soil suitability map. Such a specification would be too restrictive in terms of the precision of the 1967 report. However, to require a soil investigation as a condition of building permit approval as described in Section 1109(c) of the Plumbing Code, would provide a reasonable control commensurate with the limitations of the 1967 report.

SECTION 7063.3. PERCOLATION TESTS AND SOIL BORINGS:

Unless the subdivision is to be served by a sanitary sewer system, the tentative map shall be accompanied by the results of percolation tests and soil borings conducted in the subdivision. The report on such tests may be included in the final geological-hydrological report. The percolation tests shall be adequate in number to show the absorptive ability of the soil throughout the subdivision and the type of soil existing beneath the absorption area throughout the subdivision. A high percolation rate in conjunction with a high slope area shall be reported and corrective measures proposed. Such percolation tests and soil borings shall be conducted in accordance with procedures and standards established by the Federal Housing Administration in effect on the 27th day of May, 1969, and shall be conducted under the supervision of the County Health Department.

SECTION 7063.6. SOIL INVESTIGATION:

(a) If the final geological-hydrological report indicates the presence of critically expansive or loosely deposited soils or other soil problems which, if not corrected, would lead to structural defects, a soil investigation of each affected lot in the subdivision shall be prepared by a registered civil engineer or registered geologist. The soil investigation shall recommend corrective action which will adequately prevent structural damage to each dwelling proposed to be constructed on such soils. The report of the soil investigation shall be filed with the County Building Engineer.

(b) The County Building Engineer shall review the soil investigation report and, if he determines that the recommended corrective action will adequately prevent structural damage to each dwelling to be constructed in the subdivision, he shall approve it. If the County Building Engineer determines that the recommended corrective action will not be adequate, he shall notify the person preparing the report of the inadequacies. Until the County Building Engineer determines that the report, or amended report, contains recommendations that meet with his approval, the final subdivision map shall not be approved. All building permits issued for construction of dwellings in the subdivision shall be conditioned upon the incorporation of the approved recommended corrective action in the construction of each dwelling. Appeal from such determination shall be to the local appeals board established pursuant to the Uniform Building Code.

These sections of the ordinance are designed to further insure that the capabilities of soils to absorb sewage effluent and provide adequate foundation support are accurately determined. The requirements apply to parcel maps as well as subdivisions. Again, the standards described in Chapter VI can be used to help determine the need for, and the adequacy of these investigations.

These sections of the subdivision regulations form the basic framework of rules requiring the use of soils information in subdivision design. A few modifications may be necessary to coordinate and streamline the regulations in accordance with proposed amendments to the zoning ordinance. However, for the most part these existing rules are consistent with the basic concepts and policies proposed herein.

A-3 PLUMBING CODE

Chapter II of the Uniform Plumbing Code contains the regulations which govern the building of public sewers and private sewage disposal systems. Adequate soils information, precisely delineated on soil suitability maps, can be extremely useful in the effective administration of these regulations. However, without this soils information, the County Building Department cannot effectuate all of the regulations pertaining to this type of construction.

At present, land which is divided through subdivision or parcel map procedure is thoroughly checked for suitability for septic tank filter fields. Unfortunately, this requirement has not always been a part of the subdivision and parcel map code. Thus, even today, many vacant urban-size lots still exist which have not been subjected to this type of investigation. The Building Department does have the authority to require percolation tests under Section 1109(c) of the Uniform Plumbing Code. This Section reads as follows:

Section 1109 Drawings and Specifications

> The Administrative Authority, Health Officer or other Department having jurisdiction may require any or all of the following information before a permit is issued for a building sewer or a private sewage disposal system, or at any time during the construction thereof.

B. PLANNING POLICY

Establishment of goals is a core activity of the planning process. Once established, they become the basis upon which operating governmental agencies structure their activities. There are six broad-range goals of the Environmental Resources Management Element:

(1) To preserve and enhance the quality of life of present and future generations by preventing the degradation of the natural environment, by taking steps to offset and alleviate degradation that has already occurred and by seeking an optimum balance between the economic and social benefits to be derived from the County's natural resources.

(2) To seek a distribution of the full range of benefits of resource management as widely and equitably as possible and to avoid decisions which result in disadvantages to specified areas. Where disagreements occur, the County should seek to reconcile differences for the public good and to stand as the protector of her resources when special interests demands would be made upon the County at the expense of the people of the County, the region, the State and the nation.

(3) To preserve for subsequent generations the greatest possible range and freedom of choice in the use and enjoyment of the County's natural resources - to maintain as many options for the future as reasonably possible, consistent with the need for action in the short term.

(4) To seek to increase the appreciation of local residents of their natural environment, to deepen their appreciation of it as a source of human enrichment vital to their existence, and to elicit their constructive support for policies and programs developed in support of the goals for Tulare County; to assume (the County's) share of responsibility in preserving adequate examples of the natural (or near natural) landscape; to assume initiative in identifying and preserving those ecological units which warrant preservation in the national, State, regional and local interest.

(5) To contribute to the highest possible, long-range income of its citizens at the least possible cost in human and material resources, and to seek an equal opportunity for all citizens to share in the fuller life thus provided.

(6) To seek ways to organize and promote an efficient and effective combination of public and private effort in seeking to attain Tulare County's environmental resources management goals; some form of high-level intergovernmental mechanism should be sought which will permit adequate participation by local government.

These broad-based environmental resources management goals provide the basis against which all policies, programs and expenditures are to be judged. Collectively, these goals identify the broad guidelines for effective management of the environment.

In order for these goals to become realized, however, requires the consideration and adoption of public policy. Policies are, simply, the course of action adopted and pursued in attaining goals or achieving objectives. They set a more specific framework for action and form the basis upon which individual development decisions are made. In other words, planning policies constitute a connective link between general, wide-range planning goals and specific recommendations and actions.

Planning policies are normally formulated in response to an issue, problem or crises situation. They operate best when formulated in advance of crises. The proposal of planning policies, responsive to soil related problems and issues discussed herein, is a core element of the planning program of and for the people of Tulare County.

The integration of soil studies into the planning process is the basic function of the Soils Element of the ERME. Engineering interpretations of soil characteristics and behavior have long been determinents in subdivision design and in the administration of the Zoning Ordinance. Additional commitments are needed, however, to insure that a knowledge of soils becomes a prerequisite for all decisions regarding physical development, public or private. This involves assurances by local legislative bodies to recognize the importance of soils information in the day-to-day decision-making process of carrying out the General Plan.

The ensuing section of this report outlines various policy statements based wholely, or in part, upon soils knowledge. These statements should be adopted as a part of the network of policies and programs based upon the integrated ERME.

B-1 GROWTH POLICIES

(a) Areas dominated by soils which exhibit severe limitations for urban development shall be retained in open-space or low intensity uses.

Actions:

This policy can be implemented by appropriate zoning of these areas. The A-1 (Agricultural) and AE (Exclusive Agricultural) districts (especially AE-80) are best suited to these areas as they limit subdivisions and intensive urban development. The minimum parcel standard required in these zones should be considered the basic "rule" in these areas. In addition, where conditions are exceptionally severe, more restrictive parcel size regulations should be required to limit parcel size minimums to 40, 80 or perhaps even larger sizes depending upon economic use possibilities.

Local agencies should also consider the adoption of soil overlay zones in order to literally provide an added layer of protection against especially difficult soil hazards. At a minimum these should include provisions which recognize the hazards of shrink-swell behavior, steep topography and poor absorptive qualities for sewage disposal.

Local governments should also recognize that growth inducing activities (in some cases) could create pressures for development of unsuitable land. One of the functions of the environmental impact report process (see next section) is to identify growth inducing impact. Agencies should discourage any such activity which induces the urbanization of difficult soils.

The actions necessary to implement the policy should be applied without exception to difficult soil areas located outside Urban Area Boundaries. Where such soils fall within these urban limits, however, exceptions to these restraints may be justified when coupled with physical systems to offset or nullify the hazards. Low density, agricultural zoning cannot be arbitrarily applied without also recognizing other economic values of the land for urban development. These facts must be considered along with the physical limitations of the land. Thus, within urban area boundaries, urban-density zoning may appropriately be applied providing long term physical systems are incorporated in the development to compensate for the soil hazard.

However, controlling agencies must take actions to insure that development of such lands will not endanger life and property. Such actions should, at a minimum, include:

(1) Require public sewer connections in areas having severe restraints for septic tank filter fields, regardless of the distance to the nearest facility.(If it is too far to the nearest access to the sewer system, then perhaps the development is premature.)

(2) Require special engineering specifications in areas having poor foundation support because of shrink-swell, low bearing strength or other features.

(3) Require flood control facilities in areas susceptible to flooding or ponding.

(b) Areas classified as prime agricultural land shall be preserved for agricultural use.

Actions:

Agricultural zoning along with the application of the Land Conservation (Agricultural Preserve) Program provide the current best set of tools to implement this policy. Agricultural zoning should be applied without exception to all areas considered as prime agricultural land unless already urbanized. Pressures to convert such land to urban uses should be rejected at all costs. For example, land which has been removed from production or has been decimated by soil-born disease or plain mis-management is not sufficient justification for substitution of urban development. Intrusion of urban uses into prime agricultural land can have severe impact upon the agricultural economy and culture of an area. Not only does such development remove land from production, it also serves to restrict or confine agricultural operations in the immediately surrounding land. In addition, speculative land values associated with such development may accelerate in the area (driving up property taxes) to a level where it is difficult to produce enough wealth, through continued agricultural use, to offset the inflated land tax.

The agricultural industry requires protection from the unnecessary infusion of urban uses, and the Board has responded by applying protective exclusive agricultural zoning in extensive areas of the County. In addition, the agricultural preserve program has proven successful in stabilizing property taxes in regions undergoing the pressures of urbanization.

Some of the prime agricultural land in the County is located within Urban Area Boundaries. The County and the cities, by creating these boundaries, have collectively agreed that these areas be reserved for future urban expansion. It is an unfortunate fact that most of these areas have highly productive agricultural soils. Thus, it is the policy of the County that these prime soils within the Urban Area Boundaries, be ultimately converted to urban use.

The total combined area within all urban area boundaries in the County is approximately 93,000 acres, 90% of which has soils **rated as** prime agricultural land. This represents a substantial utilization of land for the needs of urbanization. Furthermore, it makes it all the more vital that land outside these boundaries be preserved for agricultural production.

It is a commonly accepted fact that the Urban Area Boundaries contain much more area than can reasonably be expected to urbanize by the year 2000. In defense of this criticism, it must be emphasized that the Urban Area Boundaries outline the ultimate or final limit of metropolitan growth in the County in the foreseeable future. Thus, it is to be expected that much of the arable land lying <u>inside</u> these boundaries will remain in agricultural use for some time. It should be the policy of the Board to see that these authentic agricultural operations are not "forced out" prematurely by scattered urban growth. Stated simply, *the urban area boundaries must not be used to justify leap-frog or scattered development.*

Instead, local government should adopt a system of progressively zoning land for urban or suburban development as extensions of existing urbanized areas. Enough land should be zoned to provide for urban land demand for the succeeding five years. Every year, the area would be investigated to determine where additional vacant lands within the Urban Area Boundaries should be added to make up those lost to development. Under no circumstances should it be necessary to approve a rezoning application from agricultural to urban type classification. Rather, because enough land is available at all times to satisfy the five year need, there would be no reason to allow additional urban zoning outside this area. In order to allow for speculations, a specific set of rules for new designations should be published and used. Any person might then predict the expansion in terms of such a "growth policy".

(c) <u>Groundwater recharge areas shall be reserved in open space usage wherever they are found.</u>

Actions taken to implement this policy should foster the discouragement of extensive areas of impervious materials covering the surface of the ground. These would include parking lots, streets and highways, and any use which results in the intensive utilization of the land. Rather, the Board should encourage continued agriculture, parks, athletic fields, and other open space uses as the most beneficial use of this type of land.

As most of the best groundwater recharge areas are found in rural parts of the County, agricultural zoning and agricultural preserves, which conserve the open nature of the land, are the most appropriate regulatory control. Thus, agricultural zoning and agricultural preserves again are considered the most effective tools to encourage open space use of the land. Fortunately, most such areas are now protected by existing zoning and preserves.

Groundwater recharge should also be a consideration in the location of public facilities. For example, schools having extensive open areas in playgrounds and athletic fields are considered highly compatible with recharge areas. School sites choice should require groundwater recharge as one basis of selection. This concept would apply as well to any public park or playground facility and especially groundwater recharge ponds developed by local irrigation districts.

A significant share of the good aquifer recharge area in the Valley is situated within Urban Area Boundaries. Thus, it is a foregone conclusion that much of this important resource will be endangered by the development of urbanization.

While recognizing the importance of allowing "room-for-growth", it is equally important that the development of such areas be done in a way which preserves (at least partially) some of the recharge function. Thus, in areas that have been set aside for urban growth, local governing agencies should seek to encourage urban designs which include open areas, green space, and use of porous paving.

In order to implement this principle, the Board could establish a minimum coverage requirement within the zoning ordinance which would apply to recharge areas. For example, a 50% coverage standard in an R-1 Zone would provide that the amount of area to be covered by impervious surface, including streets, sidewalks, parking lots, buildings, patios, etc. could not exceed 50% of the total area of the lot at any time. On the surface, this technique would appear to satisfy both the need to preserve recharge areas and the need to provide space for urban demands. However, this kind of technique would also tend to lower considerably the density of residential areas. This would have the negative result of increasing the gross amount of land needed for urban development, accelerate the loss of prime arable land, and generate increased transportation, transit, and public service costs.

Other ways to preserve aquifer recharge capability in urbanizing areas must be found. One possibility is to award "incentives" to developers who retain open space in their projects through "clustering" techniques. These incentives could take shape as: increased density allowances above standard zoning limits, as a trade-off for open areas, preferential tax treatment, a public maintenance of open space areas, or other benefits. The objective is to make this kind of design so attractive to developers that they will reject contemporary sprawled, low level subdivision design in favor of cluster development. In this way, an intense use of the land can be achieved without destroying that important natural resource.

(d) Significant deposits of sand and gravel should be reserved as open space until they can be developed.

Deposits of sand and gravel should be protected from urban intrusion until these materials can be extracted. This can be achieved best through open space or agricultural zoning. Once the deposits have been extracted, the zoning could revert to a "higher" use category depending upon the proposed sequential use of the land.

The point here is that within Urban Area Boundaries, the final or ultimate use of the land has been determined to be urban or urban-related. Thus, deposits of building materials located within these areas should be extracted before urban development makes it difficult, or impossible. Any significant deposits of sand and gravel within urban areas should be identified and marked on a Countywide resources map. The Board should adopt a policy, similar to "windsheds", which creates a temporary buffer zone in and around the deposit. The buffer zone would prohibit urban- intensity development until the materials have been extracted and the site reclaimed for urban use.

How is it possible to encourage development of these deposits if more profitable sites are found outside urban areas. The Board could adopt a policy which provides that no new excavation permits be granted outside urban areas until deposits within these areas are developed, however, it would be expected that extraction companies would act to protect their own long-term interests. (Note: Expansion of existing excavation areas would rightfully be excluded from such a policy.)

B-2 LAND CAPABILITY ANALYSIS

Land capability analysis is a sophisticated research tool which can be extremely useful as a preliminary or support study leading to the development of general or specific land use plans. This study technique assumes that instead of prescribing arbitrary planning or design criteria for an area, it might be in order to first find the "plan" that nature has already laid down. The basic principal is that the aquifers, difficult soil areas, slopes, floodplains and other physiographic determinants should be identified and mapped, and the design that shines through ought to be the core of the plan.

The land capability technique involves a rigorous inductive analysis of all physical factors bearing upon the use of the land. Economic and social factors should also be given weight in the final plan-making stages. However, the underlying concept is that nature should come first, or at least be carefully accommodated in development proposals.

Soil surveys and interpretive maps provide substantial bases for carrying out a land capability analysis. For example, detailed maps showing the following soil-related characteristics would be highly useful in such a study:

Sloping topography
Soil limitations - foundations
Soil limitations - water table
Soil limitations - septic tanks
Soil erosion
Hydrology - aquifer recharge
Soil drainage
Flood prone areas
Prime agricultural land
Sand and gravel deposits
Woodland suitability - quality
Range sites - quality

In addition to soil factors, other physiographic features to be compiled and mapped would include the following:

Bedrock geology
Natural climax vegetation
Land use
Forest-ecological associations
Wildlife habitats
Historical features
Scenic land
Scenic water
Natural boundaries - barriers
Surface water - natural and man-made
Groundwater reservoirs
Windsheds
Watershed boundaries

The basic method of analysis is to chart all these physical factors on a map or map overlays and see what kind of picture emerges. In actual practice, the process is much more complex than that.

For one reason, the interpretation of the map is very difficult as the patterns of nature are highly irregular in shape. In addition, there will be extensive overlapping which will further complicate the analytical process. This is because it is hard to imagine a place in the physical environment which retains no limitation for use of any kind. Thus, in order to carry out a workable planning program based upon physical determinants, certain value judgements must be made.

The process of attaching values to the physical factors identified on the map is too complex to define here. In general, the procedure includes the identification of a set of plausible values or objectives which enable the technician to better understand and interpret the map. In the final analysis, however, sets of objectives may be devised resulting in a number of alternative proposals. The development of alternatives is necessary in that it provides the decision-makers with a clear picture of the consequences of each objective. Thus, planning decisions can be made with all facts relating to the soils environment at hand.

What are the public values that should be associated with soils? Given some knowledge about soils as provided in this report, it is possible to construct a series of value statements which recognize the function of soil behavior in the ecosystem. It is recommended that the following statements be given recognition as "public values" upon which land capability analysis would be based:

1. AQUIFER RECHARGE - Aquifer recharge areas serve a valuable public purpose in that these areas, more than any other, contain the physical properties necessary to convey surface water to groundwater reservoirs. Because of current overdraft conditions in many parts of the Valley, it should be in the highest public interest that these areas remain free of impermeable surfaces wherever possible.

2. LOW BEARING STRENGTH - Areas characterized by unconsolidated materials and/or shrink-swell behavior exhibit major limitations for building foundations and roadways. Allowing urbanization of these areas can only result in increased public and private costs associated with additional construction costs, maintenance and potential property damage. It is, thus, in the public interest that such areas be maintained in open space use.

3. PRIME AGRICULTURAL SOILS - Tulare County is endowed with extensive areas of prime agricultural soils which are a unique and rare occurrence in nature. The soils constitute some of the best arable land in the world and should be used for agriculture or preserved in open space at its highest and best use. It should be in the highest public interest that these lands be protected from non-agricultural encroachment. Only where these soils are located inside established Urban Area Boundaries should they be considered "available" for urban development.

4. EROSION POTENTIAL - The problems of erosion and sedimentation affect everyone. Erosion and sedimentation cause land degradation through scouring and sediment damage; reduce storage capacity of lakes and reservoirs; cause damage to transportation facilities; increase the incidence of flooding and reduce the attractiveness of water-based recreational activities. Areas possessing a high potential for accelerated erosion should be reserved for low intensity use so that erosion-sedimentation potential is minimized.

5. WETLANDS - Areas characterized by poor surface drainage or flooding potential are hazardous to life and property. The public interest would be jeopardized if intensive use of these areas is permitted. Land which is subject to these hazards should be conserved for agriculture, recreation or open space use.

6. SLOPING TOPOGRAPHY - Excessively sloping land (over 25% slopes) is extremely difficult to develop into intensive use without degrading land, water and wildlife resources. The inherent instability of most steeply sloping land necessitates careful design and construction techniques for hillside development. It is in the public interest to reserve steeply sloping land in open space use where more suitable topography is available for development.

7. WASTE DISPOSAL - Some soils are inherently unsuitable for on-site absorption sewage systems. If the soil is unable to remove or nullify harmful substances and transmit sewage, serious health hazards could result. It is in the public interest that where such soils are found, other means of sewage disposal should be sought. Such land should be retained in open space use unless the area is situated within Urban Area Boundaries.

8. CONSTRUCTION MATERIALS - Rock, sand and gravel deposits are essential to the growth and prosperity of the County because they are basic to the construction industry. Locational factors are vitally important since deposits, obviously, must be recovered where they are found. It should be in the public interest that these deposits be developed before the land lying above is converted to urban use.

In this report, the spatial distribution of these different soil characteristics and behavior within the County are described on a generalized basis. These are much too generalized for highly detailed land capability analysis on a precise scale. However, they are suitable for general planning on a regional or Countywide scale. Thus, it is feasible to initiate a generalized Countywide land capability analysis with the soils information currently available. As more information regarding wildlife habitats, vegetation, geology and the like, becomes available through the ERME program, the land capability analysis will become more precise and growth policies will be refined. Furthermore, an up-to-date detailed soil survey, whenever it becomes available, will add more refinement to the analytical process and provide a basis for detailed planning work by small areas.

C. ENVIRONMENTAL IMPACT REPORTS

In order to carry out the meaning and intent of the California Environmental Quality Act (CEQA) of 1970, all agencies of local government must see that activities of private individuals, corporations or public agencies having effects upon the quality of the environment, are so regulated that major consideration is given to preventing environmental damage. This is accomplished through the preparation of environmental impact reports for projects which result in physical impact on the environment.

Environmental impact reports are defined in the Guidelines prepared by the Resource Agency of California as follows:

> *An Environmental Impact Report (E.I.R.) is an informational document which, when fully prepared in accordance with the CEQA and these Guidelines, will inform public decision-makers and the general public of the environmental effects of projects they propose to carry out or approve. The EIR process is intended to enable public agencies to evaluate a project to determine whether it may have a significant effect on the environment, examine and institute methods of reducing adverse impacts, and consider alternatives to the project as proposed. These things must be done prior to approval or disapproval of the project. An EIR may not be used as an instrument to rationalize approval of a project, nor do indications of adverse impact, as enunciated in an EIR, require that a project be disapproved -- public agencies retain existing authority to balance environmental objectives with economic and social objectives.*

In Tulare County, a special section of the Planning Department performs most of the functions involved in the EIR process under the guidance of the Environmental Review Committee (composed of representatives of Planning, Public Works, and Health Departments).

Soils information is often a major environmental consideration in the preparation of these reports. Currently, however, the staff has no specific guidelines for evaluating the nature of the environmental impact of certain types of uses on soils. Thus, the task here is to identify the soil related characteristic which should be routinely investigated, in all environmental impact statements. The following guidelines are recommended for adoption as staff policy in the preparation of soils information as an element of EIR's.

I. NAME & LOCATION

a. Name - State the name of the soil type, series and/or association found or identified on the property.

b. Source - indicate the source of this determination.

c. Location - describe the location of the soils on the property.....use map if necessary.

II. SOIL CHARACTERISTICS

a. General description - a general description of the soil including typical horizons, physical and chemical characteristics can usually be secured from existing soil reports.

b. Specific characteristics - at a minimum, the following characteristics of the soil should be defined:

1. Texture.
2. Slope-erosion hazard.
3. Permeability.
4. Drainage.
5. Flood hazard.
6. Hydrologic group.
7. Bearing strength - shrink/swell.
8. Depth to bedrock or impervious layer.
9. Depth to seasonal water table.

c. Other information - if the proposed project is a tentative subdivision or parcel map, the soils information provided by the subdivider should be reviewed and summarized. Any inconsistencies between the soil survey information and that provided by the subdivider should be resolved.

III. AGRICULTURAL CAPABILITY

a. Land capability classification - note the land capability classification assigned to the area by the Soil Conservation Service....make a determination of whether or not the soils are considered prime agricultural soils.

b. Production capability - using the reports provided by the Soil Conservation Service, define the crop producing capability of soil, types of crops that can be grown, and management problems, if any.

IV. SOIL SUITABILITY OR LIMITATIONS FOR INTENDED USE

a. Soil suitability - the soils reports and maps provided through the Soil Conservation Service contain a variety of soil interpretations for various types of uses (see Chapter VI of this report)....based upon the type of project, the planner preparing the EIR should determine which interpretations need be included.

b. Limitations - where soil limitations to the proposed use are indicated, the magnitude of the limitation should be defined and corrective measures suggested....In the event there is evidence that the proposed project could adversely affect a prime natural resource (e.g. - groundwater recharge areas), this also needs to be defined and clarified.

V. EVALUATION AND CONCLUSION

a. Potential adverse effects - The principal concern of EIR's is the determination of any potential adverse environmental effects which may result from a proposed project... at a minimum such determinations as related to soils should include a consideration of:

1. Potential accelerated erosion and sedimentation.
2. Degradation of water quality.
3. Ability of soils to adequately absorb domestic sewage (if private septic tanks are to be used).
4. Stability of soils for foundation support and road fill.
5. Flood and ponding potential.

VI. REFERRALS

All EIR's should be routed through the local office of the Soil Conservation Service. Here the determinations regarding soil behavior in relation to a particular project may be checked for accuracy by professional soil scientists. This lends credibility to the findings made in the EIR and tends to avoid potential conflicts when reviewed before the public. In those cases where EIR's need to be prepared for projects proposed within the western boundary of Sequoia National Forest, the soil scientist for the Forest Service should be consulted.

The above outline expresses a methodology by which the researcher may quickly ascertain and evaluate soil conditions in relation to a proposed project. The researcher should also note that soils need to be considered in relation to other aspects of the physical environment (e.g.... surface water, vegetation, wildlife, climate, etc...). Attempts should be made to ascertain and define the kind of events that occur when residual soil material is disturbed in the natural setting. For example, eroded material or sediment generated from a road cut may eventually be deposited within the bed of a stream or within a lake. If significant, this deposition could have serious effects upon these habitats. The identification of the nature of these kinds of effects is a mandatory component of any EIR.

The importance of the above determination takes on added meaning in that EIR's are required to be prepared only for those projects which will have a significant effect on the environment. "Significant effect" is simply defined in the State Guidelines as pertaining to any project which has a substantial adverse impact on the environment. The guidelines further require that where any of the following conditions are found to exist as a result of a project, the project will be found to have a significant impact on the environment.

(a) Impacts which have the potential to degrade the quality of the environment, curtail the range of the environment.

(b) Impacts which achieve short-term, to the disadvantage of long-term, environmental goals. A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time while long-term impacts will endure well into the future.

(c) Impacts for a project which are individually limited, but cumulatively considerable. A project may impact on two or more separate resources where the impact on each resource is relatively small. If the effect of the total of those impacts on the environment is significant, an EIR must be prepared. This mandatory finding of significance does not apply to two or more separate projects where the impact of each is insignificant.

(d) The environmental effects of a project will cause substantial adverse effects on human beings, either directly or indirectly.

It is impossible to precisely define what is meant by the term, "significant impact" as used in the State Guidelines. Obviously, the significance of a given activity may vary considerably from place to place under different physical and social surroundings. The State Guidelines admit this deficiency and are quick to recommend that where there exists...."a difference of opinion on whether a particular effect should be considered adverse or beneficial, but where there is, or anticipated to be, a substantial body of opinion that considers or will consider the effect to be adverse, the public agency should prepare an EIR to explore the environmental effects involved".

It is possible, however, to identify some soil-related events than can and do occur as a consequence of different types of projects, and which should be considered as "significant impacts" as intended in the State Guidelines. These would include the following:

(a) Activities which result in the degradation of the landscape. These include events which cause disturbance or removal of vegetative cover so that the soil surface remains unprotected for any significant period of time. Many of the activities associated with subdivision or land development fall under this category. These include surface grading, road cuts, and fills for roads and building pads.

(b) Any activity which results in, or influences, intensive urban development growing or expanding onto hazardous soil areas. Such areas would at least include: Unstable or subsidence-prone areas; areas having severe shrink-swell behavior and/or low bearing capacity; flood prone areas; areas of steeply sloping or hazardous topography; and areas characterized by low permeability and/or poor drainage.

(c) Any activity which causes the installation of solid or liquid waste disposal operations and facilities (including individual septic tanks) in unsuitable soil areas. These unsuitable soil areas usually are characterized by high seasonal groundwater, shallow soils, and/or high flood or ponding potential.

(d) Any activity which results in the diminishment or loss of a vital natural resource. These include aquifer recharge areas, prime agricultural land, and areas having significant values for recreation, natural vegetation and/or wildlife.

Although not intended to cover all possibilities, the above list should aide the Environmental Review Committee in determining whether or not an EIR should be prepared.

D. CALIFORNIA LAND CONSERVATION ACT

The California Land Conservation program was formulated by the State Legislature in order to protect the agricultural, wetland and scenic areas of the State from unnecessary or premature conversion to urban uses. In Tulare County the program is carried out through the provisions of the Land Conservation Act of 1965 (as amended) and Sections 421 to 429 of the State Revenue and Taxation Code.

The program is indicative of the widespread concern of the people of the State of California for the preservation of agriculture as the State's prime economic activity and the natural environment and recreation or scenic values.

In establishing the Williamson Act as a protective instrument, the Legislature recognized:

a. That the preservation of a maximum amount of the limited supply of agricultural land is necessary to the conservation of the State's economic resources, and is necessary not only to the maintenance of the agricultural economy of the State, but also for the assurance of adequate, healthful nutritious food for future residents of this State and Nation.

b. That the discouragement of premature and unnecessary conversion of agricultural land to urban uses is a matter of public interest and will be of benefit to urban dwellers themselves in that it will discourage discontiguous urban development patterns which unnecessarily increase the costs of community services to community residents.

c. That in a rapidly urbanizing society agricultural lands have a definite public value as open space, and the preservation in agricultural production of such lands, constitutes an important physical, social, esthetic and economic asset to existing or pending urban or metropolitan developments.

d. That land within a scenic highway corridor or wildlife habitat area has a value to the State because of its scenic beauty and its location adjacent to or within view of a State scenic highway or because it is of great importance as habitat for wildlife and contributes to the preservation or enhancement thereof.

Hence, public actions which have as their goal the perpetuation of agriculture as an economic activity, and as general open space, the halting or control of urban sprawl, and the preservation of high-capability agricultural land respond to the public interest as defined by State Law and the State Constitution.

The major thrust of the California Land Conservation Program as administered locally is to guarantee the continued agricultural use of the County's best (prime) agricultural land. This has proven to be a difficult objective to achieve since most of the urbanizing areas within the County are situated on prime agricultural soils. Thus, some of the most productive soils of the County become converted to non-agricultural use every year due to the outward expansion of the County's towns and cities within their established Spheres of Influence.

In recognizing the need to preserve "room for growth", the Board of Supervisors has established policy which outlines the conditions under which Preserves may be approved or disapproved. Assuming all uses within a proposed Preserve correspond with the adopted governing uniform rules, approval is then based entirely upon locational considerations. The Table below summarizes the basic policy:

AGRICULTURAL PRESERVE
LOCATIONAL POLICY

Location of proposed Preserves related to Urban Area Boundaries	Board of Supervisors Policy
1. Outside absolute limits of potential urbanization (Urban Area Boundary). . . .	Unconditional approval
2. Within Urban Area Boundary.	Approval of Preserves with 5 year review.
3. Within 5-10 year growth area	Selective approval for ten years only of Preserves with short life span crops.
4. Within 5 year growth area	Prohibit Preserves

This policy is realistic in that each city or community has a right to expand within its immediate hinterland, yet not to the extent that such expansion would significantly endanger the agricultural economy of the County. It will probably be many years before the true effectiveness of agricultural preserves will become known. To date, there have been few pressures to expand non-agricultural development into areas under agricultural preserve contracts. However, it would appear from the evidence gained in first few years the County has administered the program, that the Land Conservation Program may prove to be the most significant implementing device used to achieve the objectives of the various elements of the General Plan.

The reason is simply this: every year more and more land is placed in the Land Conservation Program. At present nearly 900,000 acres in the County are under contract. By the end of fiscal year 73-74, the total should approach 1 million acres with over 40% being prime agricultural land. This represents a substantial commitment of both land owners, and County administrators and elected officials to maintain and preserve the agricultural industry of the County. The concurrent conservation of the soils resource is implicit in the program.

Glossary

GLOSSARY

(Adapted from the Glossary of Soil Science Terms, Soil Sci. Soc. Proc., and the Soil Survey Manual, USDA-SCS)

Aggregate - A mass or assemblage of soil particles, more or less firmly held into a structure unit.

Alluvium - Sedimentary material, deposited by flowing water in the flood plain of a stream.

Association, soil - A group of defined and described soils that is regularly geographically associated.

Available water holding capacity - The capacity of a soil to retain water than can be readily absorbed by plant roots; generally expressed as a percentage of the oven-dry weight of the soil; considered to be water held in the soil against a pressure of less than 15 bars.

Bedrock - The solid rock underlying soils at a depth from zero to several hundred feet.

Calcareous soil - Soil containing sufficient calcium carbonate, often with magnesium carbonate, to effervesce visibly when treated with cold 0.1 normal hydrochloric acid.

Clay - (1) - A soil separate consisting of particles of less than 0.002 millimeters in equivalent diameter. (2) A soil texture class that contains more than 40 percent clay, less than 45 percent sand, and less than 40 percent silt.

Claypan - A dense, very slowly permeable soil horizon, high in clay, and often high in exchangeable sodium.

Clay film - A thin coating of clay on the surface of a soil aggregate.

Colluvium - Sedimentary material, moved largely by gravity, deposited at the base of a slope.

Compressibility - Properties of a soil pertaining to its susceptibility to decrease in volume when subjected to load.

Consistence, soil - The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose - Noncoherent; will not hold together in a mass.

Friable - When moist, crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed into a lump.

Firm - When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic - When wet readily deformed by moderate pressure but can be pressed into a lump; will form a wire when rolled between the thumb and forefinger.

Sticky - When wet, adheres to other material; tends to stretch somewhat and pull apart, rather than pull free from other material.

Hard - When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft - When dry, breaks into powder or individual grains under very slight pressure.

Damaging flooding - involves damage or injury to site, facilities or people.

Drainage - The rate or extent of removal of water from the soil.

7 classes of soil drainage are recognized, as follows:

Very poorly drained - Water is removed from the soil so slowly that the water table remains at or near the surface the greater part of the time. Soils of this class usually occupy level or depressed sites and are frequently ponded.

Poorly drained - Water is removed from the soil so slowly that the soil remains wet for a large part of the time. The water table is commonly at or near the surface during a considerable part of the year.

Somewhat poorly drained - Water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time. Somewhat poorly drained soils commonly have a slowly permeable layer within the profile, a high water table, additions through seepage, or a combination of these conditions.

Moderately well drained - Water is removed from the soil somewhat slowly, so that the profile is wet for a small but significant part of the time. Moderately well drained soils commonly have a slowly permeable layer within or immediately beneath the solum, a relatively high water table, additions of water through seepage, or some combination of these conditions.

Well drained - Water is removed from the soil readily but not rapidly. Well drained soils are commonly intermediate in texture, although soils of other textural classes may also be well drained.

Somewhat excessively drained - Water is removed from the soil rapidly. Some soils are shallow, have little horizon differentiation, and are sandy or very porous.

Excessively drained - Water is removed from the soil very rapidly. Excessively drained soils are commonly shallow, steep, and very coarse or porous.

Effective depth - The depth to which a soil is readily penetrated by roots and utilized for extraction of water and plant nutrients. Limits of depth classes are:

Depth Class	Inches
Very deep	More than 60
Deep	36 to 60
Moderately deep	20 to 36
Shallow	10 to 20
Very shallow	Less than 10

Erosion - The wearing away of the land surface by running water, wind, ice, or other geological agents. The following terms are utilized to describe different kinds of erosion:

Accelerated erosion - Erosion which has been significantly increased by human activity, or by domestic animals.

Geological erosion - Erosion caused by the action of the geological agents which have normally acted on the land surface.

Gully erosion - Erosion caused by intermittent moving water, creating relatively deep narrow channels in the land surface.

Natural erosion - Synonymous with geological erosion.

Rill erosion - Erosion caused by moving water creating many small, nearly parallel channels in the land surface.

Sheet erosion - Erosion caused by water moving more or less uniformly over the land surface.

Splash erosion - Erosion caused by the impact of raindrops on the soil surface, loosening and detaching the surface soil.

Erosion hazard - The relative susceptibility of the land to the prevailing agents of erosion.

Field capacity - The amount held against gravity or 1 atmosphere tension.

Flood Plain - The land bordering a stream, built up of alluvial sediments, and subject to inundation when the stream is at flood stage.

Gley soil - A soil formed under poor drainage, resulting in the reduction of the oxides of iron and other elements, and in gray or mottled soil colors. Often applied to soil horizons affected by poor drainage.

Gully - A relatively deep, narrow channel caused by intermittent moving water. See erosion.

Hardpan - A hardened soil horizon, in which the component soil particles are cemented by silica, lime, or iron oxide. Such horizons are usually nearly impervious to water, and are not appreciably changed in hardness with changes in moisture content.

Horizon - A layer of soil or soil material approximately parallel to the land surface, and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics.

Humus - The well-decomposed more or less stable part of the organic matter in mineral soils.

Infiltration rate - A soil characteristic which determines the maximum rate at which water can enter the soil under specified conditions. Formerly designated infiltration capacity.

Infiltration velocity - The actual rate at which water may be entering the soil at any given time.

Inherent fertility - The relative capacity of the soil to supply nutrients to growing plants, without additions of fertilizers or soil amendments.

Intake rate - The rate with which water enters the soil.

Liquid limit - Soil moisture content, in percent of dry weight, at which soil changes from a plastic to a liquid state.

Microrelief - Minor surface configurations of the land.

Miscellaneous land type - A mapping unit or designation for areas of land that have little or no natural soil or that, for any reason, are not feasible to classify as soil.

Montmorillonite - A type of clay mineral consisting of two silicon tetrahedral layers, enclosing an aluminum octahedral layer, or a 2:1 crystal lattice structure.

Mottles - A spot or blotch that differs in color from that of the matrix or ground mass of the soil; usually associated with small areas of concentration of iron or manganese oxide. The presence of mottles is generally indicative of poor soil drainage.

Nondamaging flooding or ponding - rise and subsidence of surface water without erosion or sediment damage.

Organic matter - The fraction consisting of decomposed or fresh remains of organisms which have accumulated on or within the soil.

Pan - A more or less impervious soil horizon caused by mechanical compaction or the accumulation of clay or cementing agents.

Parent material - The mineral or organic material which is relatively little affected by soil forming processes, and which more or less resembles the material from which the soil is presumed to have formed.

Ped - An individual natural soil aggregate.

Permeability - The rate at which water may penetrate or pass through a soil mass or soil horizon. Classes and their permeability rates are:

Very slow	- Less than 0.05 inches per hour.
Slow	- 0.05 to 0.20 inches per hour.
Moderately slow	- 0.20 to 0.80 inches per hour.
Moderate	- 0.80 to 2.5 inches per hour.
Moderately rapid	- 2.5 to 5.0 inches per hour.
Rapid	- 5.0 to 10.0 inches per hour.
Very rapid	- More than 10.0 inches per hour.

pH - A numerical expression of the acidity or alkalinity of the soil; the negative logarithm of the hydrogen-ion concentration. A pH of 7 denotes neutrality, less than 7 denotes an acid condition, and more than 7 denotes an alkaline condition in the soil.

Phase, soil - A subdivision of a soil type, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects management.

Piping - The movement of soil particles of percolating water leading to the development of channels.

Plastic limit - Soil moisture content, in percent of dry weight, at which a soil changes from a semi-solid to a plastic state.

Plasticity index - The numerical difference between the liquid limit and the plastic limit; it indicates the range in moisture, for which the soil is in a plastic condition.

Plowpan - A compact and relatively impervious layer of soil, formed immediately below the plowed layer; applied loosely to all compacted layers created by tillage equipment.

Profile, soil - A vertical section of the soil through all of its horizons, extending from the surface into the parent material.

Reaction - The degree of acidity or alkalinity of the soil, usually expressed as a pH value. The following reaction classes are recognized:

Extremely acid	- pH less than 4.5
Very strongly acid	- pH 4.5 to 5.0
Strongly acid	- pH 5.1 to 5.5
Medium acid	- pH 5.6 to 6.0
Slightly acid	- pH 6.1 to 6.5
Neutral	- pH 6.6 to 7.3
Mildly alkaline	- pH 7.4 to 7.8
Moderately alkaline	- pH 7.9 to 8.4
Strongly alkaline	- pH 8.5 to 9.0
Very strongly alkaline	- pH more than 9.1

Relief - The configuration or inequalities of the land surface.

Saline-alkaline soil - A soil containing sufficient exchangeable sodium to interfere with the growth of most crop plants and containing appreciable quantities of soluble salts.

Sand - (1) A soil separate consisting of particles of 0.05 to 2.0 millimeters diameter. (2) A soil texture class that contains more than 85 percent sand, less than 15 percent silt, and less than 10 percent clay.

Series, soil - A group of soils which have essentially similar properties and sequence of horizons, except the texture of the surface soil.

Silt - (1) A soil separate consisting of particles of 0.05 to 0.002 millimeters in equivalent diameter. (2) A soil texture class that contains more than 80 percent silt and less than 12 percent clay.

Slikensides - Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the base of a slip surface on a relatively steep slope, and in swelling clays, where there is marked change in moisture content.

Soil - A natural, three dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate, and living matter acting upon parent material, as conditioned by relief over periods of time.

Solum - The upper part of a soil profile, above the parent material, in which the processes of soil formation are active.

Strength, shear - The resistance of the action or force causing two contaction layers to slide upon each other, moving apart in opposite directions parallel to the plane of their contact.

Structure, soil - The combination or arrangement of primary soil particles into secondary particles or units. These secondary units may be arranged in the profile in such a manner as to give a distinctive characteristics pattern.

The principal forms of soil structure include: platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (subangular and angular), and granular. Structureless soils are single grain or massive (soil particles adhering together without any regular cleavage).

Subsoil - Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum - Any layer beneath the solum, either conforming or unconforming.

Surface soil - The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Texture, soil - The relative proportions of sand, silt and clay particles in a mass of soil. (See also clay, sand and silt.) The basic textural classes, in order of increasing proportions of fine particles are: sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay and clay. The sand, loamy sand and sandy loam classes may be further divided by specifying "coarse", fine", or "very fine".

Tilth, soil - The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated and difficult to till.

Topsoil - A presumed fertile soil or soil material, ordinarily rich in organic matter, used to topdress roadbanks, lawns and gardens.

Type, soil - A subdivision of the soil series based on the differences in the texture of the surface layer.

Water table - The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Wilting point - When the plants rate of absorption of water is not high enough to maintain rigidity.

APPENDIX I

AGRICULTURAL CAPABILITY UNITS

DESCRIBED IN TULARE COUNTY*

The soils of Tulare County have been grouped into 39 soil associations and each soil within an association has been classified into a Land Capability Unit. A brief description of each of these Land Capability Unit follows:

Capability Class I - Very deep, moderately well and somewhat excessively drained moderately coarse textured, nearly level soils.

Soils in this unit are over 60 inches deep, moderately well to somewhat excessively drained with moderate to moderately rapid permeabilities. There are no physical features limiting root and water penetration.

Textures range from sandy loam to fine sandy loam. Available water-holding capacity is 8 inches or more to a depth of 6 feet. Soil reaction range from pH 6.6 to 8.4. The soils are on 0 to 2 percent slopes. All locally adapted crops can be grown on these soils.

Capability Unit IIe1 - Very deep, moderately well to somewhat excessively drained, moderately coarse to moderately fine textured, gently nearly level sloping soils.

Soils in this unit are over 60 inches deep, moderately well to somewhat excessively drained with moderately slow to rapid permeabilities. The erosion hazard is slight. There are no physical features limiting root and water penetration. Textures range from sandy loam to clay loam. Available water-holding capacity is 6 to 12 inches to a depth of 5 feet. Soil reaction range from pH 6.1 to 8.4. The soils are 0 to 5 percent slopes. All locally adapted crops can be grown on these soils.

Capability Unit IIs6 - Very deep, nearly level, saline-alkali soils.

Soils in this unit are over 60 inches deep, moderately well to poorly drained with moderately rapid to slow permeabilities. Roots may penetrate to 5 feet. Textures range from loamy sand to clay loam. Available water-holding capacity is 5 to 11 inches depending on the salt content present. The soils are 0 to 2 percent slopes. Reclamation is recommended before salt tolerant crops are grown.

*Source: Tulare County, General Soil Survey, Soil Conservation Service, 1967.

Capability Unit IIIe5 - Moderately deep to very deep, fine textured nearly level to moderately sloping soils.

Soils in this unit are 20 to over 60 inches deep, moderately well to well drained with slow to very slow permeability. The erosion hazard is slight to moderate. Textures are clay. Available water-holding capacity is 7 to 12 inches. Soil reaction range from pH 6.1 to 8.4. The soils are on 0 to 9 percent slopes. Deep or moderately deep rooted crops do well on these soils.

Capability Unit IIIs4 - Nearly level coarse to moderately coarse textured soils with low available water-holding capacities.

Soils in this unit are over 60 inches deep, moderately well to excessively drained with moderate to very rapid permeability. Wind erosion may be a hazard. Textures range from sand to fine sandy loam. Available water-holding capacity is 2 to 7 inches to a depth of 5 feet. The soils are on 0 to 2 percent slopes. Most crops are irrigated, non-irrigated crops are largely limited to small grains and native pasture.

Capability Unit IIIs6 - Moderately deep to very deep, somewhat poorly drained, saline-alkali soils.

Soils in this unit are 18 to over 60 inches deep overlying hardpans or semi-consolidated alluvium. They are somewhat poorly drained with moderately rapid to slow permeability above the restrictive substratum. Textures range from fine sandy loam to clay loam. Available water-holding capacity is 4 to 11 inches. The soils are on 0 to 2 percent slopes. Before reclamation these soils usually have moderately to high concentration of saline and alkali salts. Potentially suited crops are cotton, sorghum, barley, irrigated pasture, corn and sugar beets.

Capability Unit IIIs8 - Moderately deep, well drained, nearly level, moderately coarse to medium textured soils with very slowly permeable hardpans on semi-consolidated alluvium.

Soils in this unit are 20 to 36 inches deep overlying hardpans or semi-consolidated alluvium. They are well drained and the subsoil permeability is moderate. Surface textures range from fine sandy loam to loam. Sub-soil textures are loam and clay. Available water-holding capacity is 2 to 4 inches. Soil reaction range from pH 5.6 to 7.8. The soils are on 0 to 2 percent slopes. Locally adapted, shallow-rooted crops do well on these soils.

Capability Unit IVs6 - Deep to very deep, somewhat poorly to poorly drained, saline-alkali soils.

Soils in this unit are 30 to more than 60 inches deep, somewhat poorly to poorly drained with slow to very slow subsoil permeabilities. Roots may penetrate to 30 inches or more. Surface textures range from sandy loam to clay and subsoil textures are sandy clay loam to clay. Available water-holding capacity is 4 to 11 inches depending on the salt content present. The soils are on 0 to 2 percent slopes. This unit has severe salinity or alkali limitations. After leaching, salinity or alkali is likely to recur. Reclamation is recommended before highly salt tolerant crops are grown.

Capability Unit VIe1 - Moderately deep well to somewhat excessively drained medium textured upland soils on moderately steep slopes.

Soils in this unit are 20 to 36 inches deep overlying weathered rock. The soils have medium textures and are well to somewhat excessively drained with moderate to moderately rapid permeability. The available water-holding capacity is 3 to 6 inches. Soil reaction range from pH 6.1 to 6.5. The soils are on 15 to 30 percent slopes. These soils are well suited for range.

Capability Unit VIe8 - Moderately steep to steep, medium and fine textures, shallow to moderately deep soils over bedrock.

Soils in this unit are 10 to 36 inches deep overlying bedrock. The soils are well to somewhat excessively drained with moderately slow to slow sub-soil permeabilities. Surface textures range from loam to stony clay. Subsoil textures are clay and very stony clay. Available water-holding capacity is 3 to 8 inches. Soil reaction range from pH 6.1 to 7.8. The soils are on 15 to 50 percent slopes. These soils are well suited for range and dryland pasture.

Capability Unit VIs1 - Strongly sloping to moderately steep, moderately coarse to moderately fine textured, moderately deep rocky soils over bedrock.

Soils in this unit are 20 to 36 inches deep overlying bedrock. Rock outcrops range from 10 to 50 percent. They are well to somewhat excessively drained with moderately slow to rapid permeabilities. Surface textures are coarse sandy loam. Subsoil textures range from coarse sandy loam to clay loam. Available water-holding capacity is 3 to 6 inches. Soil reaction range from pH 5.1 to 7.3. The soils are on 9 to 30 percent slopes. These soils are best suited for range and dryland pasture.

Capability Unit VIIe1 - Moderately deep to deep, moderately coarse to fine textured soils on steep to very steep slopes.

Soils in this unit are 20 to 60 inches deep to weathered rock. They are well to somewhat excessively drained with slow to moderately rapid subsoil permeabilities. Texture in the surface layer is coarse sandy loam to loam with coarse sandy loam to clay subsoil. Available water-holding capacity is 3 to 9 inches and the erosion hazard is moderate to high. Soil reaction range from pH 5.1 to 7.3. The soils are on 30 to 75 percent slopes in the uplands. These soils are best suited for range.

Capability Unit VIIe8 - Steep to very steep, shallow to moderately deep soils over bedrock.

Soils in this unit are 10 to 36 inches deep overlying bedrock. They are well to somewhat excessively drained with moderately slow to moderately rapid subsoil permeabilities. Surface textures range from fine sandy loam to loam, and subsoil textures are fine sandy loam to gravelly clay loam. Available water-holding capacity is 1 to 6 inches. Soil reaction range from pH 6.1 to 7.3. The soils are on 30 to 75 percent slopes. These soils are best suited for range.

Capability Unit VIIs1 - Moderately deep, moderately coarse to moderately fine textured rocky soils on rolling to very steep slopes.

Soils in this unit are 20 to 36 inches deep to weathered rock. Rock outcrops range from 10 to 50 percent. They are well to excessively drained with moderately slow to rapid subsoil permeabilities. Texture in the surface layer is coarse sandy loam or loam with coarse sandy loam to sandy clay loam subsoils. Available water-holding capacity is 2 to 6 inches and the erosion hazard is high. Soil reaction range from 5.1 to 7.3. The soils are on 15 to 75 percent slopes in the uplands. These soils are best suited for range.

Capability Unit VIIIe1 - Very shallow, very steep land broken by intermittent drainage channels.

This unit consists of very shallow, very steep rough broken land ordinarily not stony. Runoff is high and geologic erosion is active. A grass and scattered brush cover may be present. This unit is best suited for recreation and wildlife.

Capability Unit VIIIw4 - Very deep, very coarse textured gravelly or stony soils subject to overflow and deposition.

This unit is barren, gravelly or stony coarse textured deposits in stream beds. This unit is best suited for recreation and wildlife.

Capability Unit VIIIs1 - Very shallow, very steep rocky uplands.

This unit consists of very shallow, very steep rocky mountainous land. Scattered brush, grass and tree cover may be present. This unit is best suited for recreation, wildlife and water supply.

APPENDIX II

STORIE INDEX RATINGS

OF TULARE COUNTY SOILS

A. Classification of the soils of the Visalia area, Survey, 1940, arranged in descending order of their index rating.

Soil type	Index
	Percent
Cajon fine sandy loam	100
Foster fine sandy loam	100
Foster loam	100
Foster sandy loam	95
Hanford sandy loam	95
Honcut sandy loam	95
Greenfield sandy loam	95
Visalia sandy loam	91
Ramona loam	90
Chino fine sandy loam	86
Chino silty clay loam	86
Tujunga sandy loam	86
Honcut loam	80
Foster fine sandy loam (spotted salt concentration)	80
Cajon fine sandy loam (slight salt concentration)	80
Chino silty clay loam (spotted salt concentration)	76
Chino clay loam	73
Chino sandy loam	73
Cajon sandy loam	72
Dinuba sandy loam	72
Farwell fine sandy loam	70
Honcut silty clay loam	68
Chino fine sandy loam (slight or spotted salt concentration)	68
Traver fine sandy loam (slight or spotted salt concentration)	68
Greenfield sandy loam, shallow phase	67
Visalia sandy loam, shallow phase (over Fresno soil material)	65
Cajon sandy loam (slight alkali)	65
Exeter loam, gravelly phase	63
Exeter loam	60
Visalia sandy loam, shallow phase (over San Joaquin soil material)	57
Dinuba sandy loam (slight salt concentration)	57
Tujunga sand	56
Delhi loamy sand	53
Exeter clay loam	51
Porterville adobe clay	51
Foster fine sandy loam, shallow phase (over Fresno soil material)	50
Chino clay loam, shallow phase (over Fresno soil material)	48
Madera sandy loam	48
Hovey adobe clay	46
Vista sandy loam	43
Cajon fine sandy loam (moderate salt concentration)	40
Madera loam	40
Lewis fine sandy loam (non-typical material)	36
Traver loam (moderate salt concentration)	36
Cajon sandy loam (moderate salt concentration)	36
Madera clay loam	34
Madera loam (slight salt concentration)	32
Dinuba sandy loam (moderate salt concentration)	29
Traver fine sandy loam (moderate salt concentration)	25
San Joaquin loam	25
San Joaquin sandy loam	24
Seville adobe clay	24
San Joaquin clay loam	21
Madera loam (moderate salt concentration)	20
Foster fine sandy loam, shallow phase (over Fresno soil material) (considerable salt concentration)	20
Las Posas stony clay loam	19
Honcut sandy loam, gravelly phase	19
Yokohl clay loam	18
Yokohl clay	18
Porterville adobe clay, stony phase (steep, erodible)	17
Vista sandy loam, rock-outcrop phase	14
Tujunga sand, gravelly phase	12
Lassen stony adobe clay	11
Traver fine sandy loam (strong salt concentration)	8
Waukena fine sandy loam (strong salt concentration)	6
Lewis fine sandy loam (strong salt concentration)	4
Lewis clay loam (strong salt concentration)	4
Fresno fine sandy loam (strong salt concentration)	3
Rough stony land (nonarable)	2
Riverwash (nonagricultural)	2

B. Rating of the soils of the Pixley area. Survey, 1942.

Soil type	Rating
Cajon fine sandy loam (alkali free)	100
Foster fine sandy loam (alkali free)	100
Foster loam	100
Hanford loamy fine sand	100
Hesperia loam (alkali free)	100
Chino fine sandy loam (alkali free)	95
Greenfield sandy loam	95
Hanford sandy loam	95
Hesperia sandy loam (alkali free)	95
Foster loamy sand	90
Honcut loam	90
Chino loam (alkali free)	86
Chino sandy loam	86
Chualar clay loam	85
Hanford loamy fine sand, shallow phase (over Madera soil material)	80

Chino fine sandy loam (slight alkali)	76
Chino loam (alkali spotted)	76
Hesperia sandy loam (slight alkali)	76
Cajon fine sandy loam (slight alkali)	75
Cajon fine sandy loam, shallow phase (over Madera soil material) (alkali free)	75
Foster fine sandy loam (slight or spotted alkali)	75
Foster fine sandy loam, shallow phase (over Madera soil material) (alkali free)	75
Hesperia loam (slight alkali)	75
Chino clay loam (alkali free)	73
Cajon sandy loam (alkali free)	72
Cajon sandy loam, shallow phase (over Chino soil material)	72
Cajon fine sandy loam, shallow phase (over Pond soil material) (slight or alkali spotted)	72
Delano clay loam	72
Traver fine sandy loam (slight alkali)	72
Ducor clay loam	68
Tulare clay loam (slight alkali)	68
Exeter sandy loam	67
Tujunga sandy loam	67
Chino loam, shallow phase (over Madera soil material) (alkali free)	66
Cajon sandy loam (slight alkali)	65
Chualar sandy clay loam	65
Cajon fine sandy loam, shallow phase (over Madera soil material) (slight alkali)	64
Foster fine sandy loam, shallow phase (over Madera soil material) (slight alkali)	64
Chino clay loam, shallow phase (over Fresno soil material) (alkali free)	62
Cajon sandy loam, shallow phase (over Madera soil material) (alkali free)	61
Cajon sandy loam, shallow phase (over Chino soil material) (slight alkali)	58
Chino clay loam (slight alkali)	58
Ducor adobe clay	56
Ducor clay loam, rolling phase	56
Chino loam, shallow phase (over Madera soil material) (slight alkali)	53
Ducor clay	51
Porterville adobe clay	51
Tulare very fine sandy loam (slight to moderate alkali)	51
Chino clay loam, shallow phase (over Fresno soil material) (slight alkali)	50
Chualar sandy clay loam, shallow phase (over San Joaquin soil material)	50
Exeter loam	50
Cajon sandy loam, shallow phase (over Madera soil material) (slight alkali)	48
Tujunga sand	48
Chualar clay	46
Hovey adobe clay	46
Ducor adobe clay, rolling phase	45
Exeter clay loam	43
Las Posas clay loam	43
Vista sandy loam	43
Linne clay	42
Madera loam (alkali free)	40
Traver fine sandy loam (moderate alkali)	36
Cajon fine sandy loam (moderate alkali)	35
Madera clay loam	34
Tulare very fine sandy loam (moderate alkali)	34
Foster fine sandy loam, shallow phase (over Madera soil material) (moderate alkali)	32
Madera loam (slight alkali)	32
Cajon sandy loam (moderate alkali)	29
Chino clay loam (moderate alkali)	29
San Joaquin loam	25
Lassen clay	24
Waukena fine sandy loam (moderate alkali)	24
Tulare clay loam (moderate alkali)	22
Tulare fine sand (moderate alkali)	22
San Joaquin clay loam	21
Diablo adobe clay	20
Las Posas stony clay loam	19
Pond loam (moderate to fairly high alkali)	18
Hacienda fine sandy loam (moderate alkali)	17
Porterville stony adobe clay	17
Tulare loam (moderate to high alkali)	17
Madera loam (moderate alkali)	15
Pond clay loam (moderate to fairly high alkali)	15
Redding gravelly loam	15
Tulare clay (moderate to high alkali)	15
Rough stony land (Vista soil material)	14
Fresno fine sandy loam (moderate alkali)	12
Lewis fine sandy loam (moderate alkali)	12
Tujunga stony sand	12
Lassen stony adobe clay	11
Cajon fine sandy loam (strong alkali)	10
Traver fine sandy loam (high alkali)	7
Waukena fine sandy loam (high alkali)	6
Pond loam (high alkali)	5
Tulare clay (high alkali)	5
Tulare loam (high alkali)	5
Fresno clay loam (high alkali)	4
Fresno fine sandy loam (high alkali)	4
Lewis fine sandy loam (high alkali)	4
Madera loam (high alkali)	4
Pond clay loam (high alkali)	4
Hacienda fine sandy loam (high alkali)	3
Rough stony land	2
Riverwash	2

APPENDIX III

SUPPLEMENTAL SOIL INTERPRETATION CRITERIA

A - Soil limitation ratings for trench-type sanitary landfill

Item affecting use	Degree of soil limitation		
	Slight[2]	Moderate[2]	Severe
Depth to seasonal high water table	Not class determining if more than 72 in.		Less than 72 in.
Soil drainage class	Excessively drained, somewhat excessively drained, well drained, and some[3] moderately well drained	Somewhat poorly drained and some[3] moderately well drained	Poorly drained and very poorly drained
Flooding	None	Rare	Occasional or frequent
Permeability[4]	Less than 2.0 in./hr.	Less than 2.0 in/hr.	More than 2.0 in./hr.
Slope	0-15 pct	15-25 pct	More than 25 pct
Soil texture[5] (dominant to a depth of 60 in.)	Sandy loam, loam, silt loam, sandy clay loam	Silty clay loam[6] clay loam, sandy clay, loamy sand	Silty clay, clay, muck, peat, gravel, sand
Depth to bedrock: Hard Rippable	More than 72 in. More than 60 in.	More than 72 in. Less than 60 in.	Less than 72 in. Less than 60 in.
Stoniness class[7]	0 and 1	2	3, 4, and 5
Rockiness class[7]	0	0	1, 2, 3, 4, and 5

[1]Based on soil depth (5-6 feet) commonly investigated in making soil surveys.

[2]If probability is high that the soil material to a depth of 10-15 feet will not alter a rating of slight or moderate, indicate this by an appropriate footnote, such as "Probably slight to a depth of 12 feet", or "Probably moderate to a depth of 12 feet".

[3]Soil drainage classes do not correlate exactly with depth to seasonal water table. The overlap of moderately well drained soils into two limitation classes allows some of the wetter moderately well drained soils (mostly in the Northeast) to be given a limitation rating of moderate.

[4]Reflects ability of soil to retard movement of leachate from the landfills; may not reflect a limitation in arid and semiarid areas.

[5]Reflects ease of digging and moving (workability) and trafficability in the immediate area of the trench where there may not be surfaced roads.

[6]Soils high in expansive clays may need to be given a limitation rating of severe.

[7]For class definitions see Soil Survey Manual, pp. 216-223.

B - Soil limitation ratings for area-type sanitary landfills

Item affecting use	Degree of soil limitation		
	Slight	Moderate	Severe
Depth to seasonal[1] water table	More than 60 in.	40-60 in.	Less than 60 in.
Soil drainage[1] class	Excessively drained, somewhat excessively drained, well drained, and moderately well drained	Somewhat poorly drained	Poorly drained and very poorly drained
Flooding	None	Rare	Occasional or frequent
Permeability[2]	Not class determining if less than 2 in./hr.		More than 2 in./hr.
Slope	0-8 pct	8-15 pct	More than 15 pct

[1]Reflects influence of wetness on operation of equipment.

[2]Reflects ability of the soil to retard movement of leachate from landfills; may not reflect a limitation in arid and semiarid areas.

C - Suitability ratings of soils as sources of cover material for area-type sanitary landfills

Item affecting use	Degree of soil suitability		
	Good	Fair	Poor
Moist consistence	Very friable, friable	Loose, firm	Very firm, extremely firm
Texture[1]	Sandy loam, loam, silt loam, sandy clay loam	Silty clay loam, clay loam, sandy clay, loamy sand	Silty clay, clay, muck, peat, sand
Thickness of material (Usually uppermost part of profile)	More than 40 in.	20-40 in.	Less than 20 in.
Coarse fragment: percent, by volume	Less than 15 pct.	15-35 pct.	More than 35 pct.
Stoniness class[2]	0 and 1	2	3, 4, and 5
Slope	Less than 8 pct.	8-15 pct.	More than 15 pct.
Drainage class (wetness)	Not class determining if better than poorly drained		Poorly drained and very poorly drained

[1]Soils having a high proportion of non-expansive clays may be given a suitability rating one class better than is shown for them in this Table.

[2]For class definitions see Soil Survey Manual, pp. 216-223.

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